THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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MR. MARCONI AT THE ROYAL INSTITUTION.

AT the Royal Institution last Friday, Mr. Marconi gave a lecture on "Recent Advances in Wireless Telegraphy." Although his title was chosen thus broadly, his remarks were entirely restricted to results obtained by the Marconi Co., and his audience were free to assume that progress was monopolised by that company. When the sense in which Tyndall interpreted "Recent Advances" is remembered, the narrowing process, which limits the scope of things considered to a lecturer's own interests, is seen to be conspicuously out of harmony with the traditions of the Royal Institution. If the title is chosen broad, broadly the subject should be treated. If it is chosen narrow, the Council should consider whether the lecture is calculated to impart the principles of scientific research, or whether it is merely an advertisement. We have in our minds an instance that occurred not many months ago at the Royal Institution, when a well-known professor was selected to give a series of afternoon lectures on an important electrical subject. He selected a broad title—it was a subject with a splendid history—but he said scarcely a single word about researches prior to his own. It is not in accordance with the traditions of the Royal Institution that the audience should be impressed with the cleverness of a lecturer, rather than with the principles demonstrated by a lecturer.

In the short time at his disposal, Mr. Marconi gave an interesting account of the work accomplished in recent years by the Marconi Co. He pointed out that there was still a prevailing impression that there is something mysterious and uncommon associated with wireless telegraphy, and he attributed this to the reports which so persistently appear in the daily Press. Recent improvements have related to the prevention of interference of messages, to the increase of the distance through which messages can be transmitted, and to the accuracy of transmission and receiving of messages. His impression was that the interference of messages with one another appeared to be much more serious to a certain section of the public than to telegraph engineering experts. He referred to the ordinary telegraph line between Cork and Crook Haven, to which several offices are connected, and where interference and confusion between ordinary telegraphic messages was possible, though they were obviated by certain rules and regulations laid down for the guidance of the officers of the Post Office. He believed he was correct in saying that up to 1902 the only receivers which could be practically employed, were based upon what might be called the coherer principle, involving the use of a "tapper," which made the system rather slow. Then followed automatic decohering, the anti-coherer, and the use of the telephone as a receiver. The telephone leaves no record of the messages, and was thought by Mr. Marconi to be otherwise lacking in trust-

worthiness. He then proceeded briefly to describe his magnetic detector, which is used in the Royal Navy for trans-Atlantic wireless work. It depends, as is well known, upon the successive cyclic magnetisations and demagnetisations of steel needles placed within an inductive coil. The magnetic field is rotated, generally, by rotating a horse-shoe magnet with respect to the core within the coil. While the magnetic field of the core is thus continuously changing, the apparatus is extremely sensitive to variations arising from changes of current in the inductive coil. The received impulses pass through the primary of the inductive coil, the relay circuit of the receiving instrument being connected through the secondary. If the rotary movement of the horse-shoe magnet ceases, the instrument is rendered non-receptive. It is also found that there is a dead point in the rotation; at the instant that this occurs, nothing can be received. To get over this difficulty, the magnet in later instruments is fixed, and an endless band of iron, or iron wire, is caused to traverse the coils. As first constructed, this relay had the disadvantage that it could not be made to actuate a recording instrument; the current impulse was too rapid to have any appreciable effect upon the tongue of a relay. By increasing the iron, by employing iron of a particular quality, and by the introduction of the moving iron band, the impulse had been successfully made to serve the required purpose, and signals could be recorded. In association with Prof. Fleming, he had introduced other improvements, the result being an instrument that was more simple, and that required less attention than the early forms. It possesses a low and uniform resistance, and could be used with high-speed automatic sending apparatus. Overland, it had worked satisfactorily for a distance of 152 miles.

In regard to the speed attained with the Marconi apparatus, transmission could now be maintained between Amsterdam and Chelmsford at an average of 24 words a minute. In the spring of 1903 the transmission of American messages to the *Times* was attempted. Owing to the breakdown of the apparatus it was discontinued, and he had decided to abstain from transmitting public messages across the Atlantic until he was quite certain that a continuous system could be ensured to the public.

He had recently been able to collect a large amount of data as to the contrary effects of daylight and night upon the Hertz waves. At distances not greater than 150 miles, no differences were observed; beyond this, the range by day was much less than by night, being occasionally something like the ratio of two to five. Mr. Marconi then referred to the success with which his system had transmitted messages over sea and land, and he said that he had not the slightest doubt that trans-Atlantic signalling would be equally satisfactory.

METERS.

Does every engineer appreciate sufficiently the necessity for checking the accuracy of the main meters? In a lighting station it is probable that a careful and constant check is usually kept, for the testing apparatus is at hand, and there is every facility for using it in the way of accommodation and staff, while the necessity for accuracy is kept fresh in the mind of the engineer by means of the ratio "units generated to units sold," which makes it desirable to prevent the main meters from reading fast, while the desire to reduce the cost per unit to the lowest figure makes it equally desirable that the main meters shall not record slow. Meters are constantly in the mind of the lighting engineer, as his revenue depends on them entirely, and it may be assumed to be most probable that he appreciates to the full the vital need of accuracy in every one, from those on the bus-bars to those on the smallest service.

Can the same be said for the engineer of a traction station? There is hardly as much probability in this case, for meters form a very small portion of the plant under his care. Beyond the meters on the bus-bars, there are none. Energy is measured at the point of consumption only in isolated cases, and then at long intervals and at a few points only for the purpose of checking drivers or distribution losses. In many—nay, most—cases the main meters are not even duplicated, although when buying from an outside source it is recognised generally that the buyer must be protected from the known vagaries of the meters by the insertion of two and sometimes three in series, the mean of these being accepted as the actual consumption so long as the readings of each do not differ from the mean by more than a certain percentage (generally 3 per cent.). Instances within our knowledge have demonstrated how essential it is to set a meter to watch a meter (not a breath of innuendo intended), and such instances must be well known to most engineers; yet in private stations which supply energy for the owners of tramways or other works, the single unchecked meter is found in possession more often than not. The reason is, simply, that nobody is buying the energy, and either the engineer or the proprietors think it unnecessary on that account to increase capital expenditure and to add, however little, to the duties of the executive and clerical staffs. Of course, it is always possible to detect a defective meter indirectly, so long as a watchful eye is on the consumption of coal or water per apparent unit generated, or as often as the works costs are worked out; but the watchful eye is not always on the spot. Moreover, a variation, either up or down, in fuel or water consumption and in cost per unit, may be due to many other things than a defective meter, and, unless the meters are tested first, on principle, some time must elapse before the source of the variation is traced, and this would involve reconciliations in the costs.

A modern tramway power-house ought to be provided with a meter on every feeder and a meter on the bus-bars, and in that case an umpire meter on the bus-bars is not such a crying necessity as when the output to each feeder is not metered.

Feeder meters are not required, solely, to give by their sum a check on the bus-bar meter, as they may be invaluable for more directly profitable purposes, and it is poor economy to strike them out of a specification. The engineer of a station where the bus-bar meter is unsupported has no direct check on the very fundamental of all his costs and calculations, and he is in a dilemma, even when he suspects the readings, for he is lucky if his testing room—if there is any place which can be dignified by that name—contains the standard instruments required for a meter test, and, in the absence of facilities, he has to make up his mind to be separated from his meter for a period determined only by some factor depending on the resistance of the instrument-maker to a mixture of hard words and prayers frequently applied, during which period the output of the station, and the duty of everything that therein is, has to be estimated.

Some of the data which depend on the accuracy of statement of output are units per car-mile, load factors, mean current, fuel and water per unit, average current per car, and cost per unit—a list long enough and important enough to make it evident that, if accurate returns are required, there must be no chance of an error in the meters remaining unnoticed.

While on this subject, it will be in order to mention the futility of many traction log-sheets. Hour after hour, day after day, the enginemen or switchboard attendants solemnly record the instantaneous readings of the ammeters, although the load varies enormously from second to second. Log-

sheets drafted on this principle are legacies of the lighting station in which load variations are much less rapid, and they were introduced by consulting engineers who turned their hands to traction after spending their professional childhood in lighting.

Obviously, the only useful half-hourly or hourly entry in a traction station is the state of the various meters.

More than all should the meters be accurate, because comparisons depend on them. Station fights station, company vies against corporation, with weapons forged out of metered units, and for fair fight these weapons must be forged true.

The Purchase of Electricity Works' Supplies.

The German Association of Electricity Works, which comprises 200 works in Germany and neighbouring countries, recently formed a purchasing bureau to which the representatives of 28 works signified their adhesion at the constituent meeting held at Munich. As the principal object of the bureau, may be mentioned the purchase on common account of materials required in connection with the operation of electricity works, and for this purpose the bureau will ascertain for members the most favourable terms upon which their requirements at any time can be satisfied, and also arrange the orders with contractors. Each member is placed under the obligation to order, with the exception of certain specified types, all his normal quantity of carbon filament lamps from the bureau, together with those materials which a general meeting of the members may decide should be bought on common account. The purchase of standard types of incandescent lamps is to be commenced first, and these will be tested both in regard to consumption of current and illuminating power. It is estimated that the requirements of the bureau will represent several millions of lamps per annum on the lowest calculation. The Continental Glow Lamp Syndicate, it is stated, has arrived at an understanding with the bureau in respect of technical questions concerning the lamps.

Surface Condensing Plants.

Mr. R. W. Allen's recent paper before the Institution of Civil Engineers on the value of condensing plant is a useful one, and should achieve its object of drawing attention to the subject. He uses the term "efficiency of vacuum" to express the relation between the vacuum actually attained and that which should correspond with the temperature of the water in the condenser, but he does not make it clear why the attained vacuum is so much less than it should be, or on what law the discrepancy is to be determined. He gives some useful information as to the air seal above air pump delivery valves. This air seal he would limit to three or four inches, and he would not place upon an air pump, when run at high speed, the duty of discharging its water against a head of water additional to the atmospheric pressure. A separate pump should be provided. Nor does he express much approval of the modern idea of using two so-called air pumps—one to pump air, the other to pump water only. He secures a good vacuum by allowing the collected condensed steam to accumulate in the bottom of the condenser, to be cooled by the lower tubes which are then immersed. By this means he reduces the temperature considerably, and largely augments the vacuum—as much as $\frac{1}{2}$ in. to $\frac{3}{4}$ in. During the experiments the chief difficulty appears to have been to keep joints air-tight. A condenser is illustrated, in which the tubes of the upper bank in a double-pass horizontal tubular condenser are more widely spaced than the tubes of the lower bank. By this means the steam which strikes first on the upper bank of tubes is afforded a more free entry between the tubes. It is well known that many makers of surface condensers omit two or three lines of tubes, so as to leave wide gaps for the steam to find its way well down among the tubes. This omission is equivalent to a lengthening of the tube wall, and allows steam, once having penetrated among the tubes, to travel laterally between them. Mr. Allen's paper contains numerous records of tests which afford information on the effect of variation of temperatures and water circulation.

ON TECHNICAL JOURNALISM.

At a meeting of the American Trade Press Association at the Hardware Club, New York City, on February 17th, Mr. Arthur Warren, manager of publicity for the Allis-Chalmers Co., delivered an interesting address entitled "A Plain Talk on Trade Journals." The *Street Railway Journal*, in giving an abstract of the address, states that Mr. Warren is not only well versed in the subject discussed, but has established a high record himself as a successful newspaper editor, correspondent and contributor. He not only considered the technical and trade journal from many standpoints, but outlined the duties of a manager of publicity for a large company and the general principles of advertising. He did not hesitate to say that there were too many trade papers in the field, and too many special issues. It is constant, systematic advertising, not spasmodic, that brings results.

Mr. Warren pointed out the essential differences between advertising a soap or a breakfast food, and pushing the sales, by advertising, of reciprocating engines, steam turbines, dynamos, motors, transformers, converters, and controllers. The advertiser of the corset and the pill appeals to the world in the bulk, and to an unsophisticated audience. The industrial advertiser did not enjoy this advantage, but addressed his claims to an audience that was trained and experienced, and technically educated along the lines of the apparatus brought forward; and quite as likely to know as much about the wares advocated as the man advocating them. These facts made a remarkable differentiation, and constituted part of the problem of trade journal advertising. The technical Press was none the less an educator, and Mr. Warren remarked that the editors of the technical and trade papers in America "yield as a body not an inch or an ell in ability and influence and character to any body of professional men in any part of the world. They make your papers powerful and respected. Publishers, as well as other leaders of enterprise, civil, religious, military, are known by their lieutenants, by the company they keep. If it were not for your editors your advertisers would be fewer. The theory is that advertisers advertise in papers that men wish to read." As to elemental principles in the treatment of advertising, Mr. Warren contended that there should be absolutely no cutting of rates; that advertising business should not be handled through agencies, and that every advertiser should buy and handle his own advertising space, design his own advertisements and realise that a publicity department was as much a necessity as a drafting room or a foundry.

This brought Mr. Warren to the question of circulation. He said that circulation had been regarded as "one of the dim gods that men cherish in silence, but the time had come when the veil of the temple must be rent." He then described in detail the canvass that he had recently made of papers in which his concern advertised, requesting definite and specific information as to the figures of circulation. On the whole, the results were gratifying, although there had been instances of undue reticence. He was glad to note the fact that in the month of January three New York publishers of trade and technical journals—members of the association—were to be found publishing in seven of their journals statements of circulation. He thought that these figures might be carried one point further, namely, in making a distinction between copies printed and copies paid for. Their example, at any rate, was one which no publisher of good standing could afford to ignore, and the next step was one which he believed all members of that representative body could afford to make.

Mr. Warren brought a most admirable, interesting, and suggestive address to a close by discussing the reading matter contained in technical papers, approving the development of the news features, and pointing out ways in which even the ordinary descriptive article of a new appliance could be made instructive. It was impossible that the engineers of any great concern could write all the articles demanded of them, as they would then do little else, and he suggested, as an alternative, that the editors themselves, or members of the editorial staff, should be allowed to circulate more freely through the shops and factories, making observations at first hand and acquainting themselves, for the benefit of their readers, with what was going on. Some papers were con-

servative in this and other respects, but he did not believe that the technical Press had yet developed the field of information.

There should be, and there can be, a closer touch between the papers and the manufacturers. And that closer touch can be obtained without the loss of any independence on the part of the Press. The papers that are not independent, the papers that are partisan and that curry favour, are the papers we don't want. The manufacturing concerns are sources of news. You want technical news, and perhaps other kinds of news. But very often, especially in regard to large undertakings, you do not get the information until it has lost its news value. There are reasons for that. Perhaps they will never be entirely overcome, because the manufacturer has not only to guard his own interests, but he has to guard the interest of his customer. When large investments are at stake, the persons who are paying the money have the privilege of keeping their own counsel. You, as business men, can understand that clearly enough. And again, when the manufacturer is producing a new invention, he prefers silence until he has protected himself by patents, completed his tests, and perhaps made a successful installation or two.

POLYPHASE METERS.

[CONTRIBUTED.]

As nowadays the accurate measurement of energy in polyphase circuits is a matter of great and increasing importance in this country, it may serve some useful purpose to give a short statement of the theory underlying those instruments which are designed and constructed to show by one single observation the true amount of power developed in such circuits. In this short article, it is proposed to deal only with watt-hour-meters, though the general principles are the same as those underlying the design of watt indicators.

It is, of course, well known that the true value of the power in a polyphase circuit can be ascertained from simultaneous observations made on two or more single-phase meters, the disadvantage of such methods being that the possible error is the sum of the possible errors of the several meters in use, to which may have to be added a further error due to the fact that the observations are not made quite simultaneously. This being the case, it is obvious that, other things being equal, an instrument which gives the true value of the power by one observation only is the best.

As far back as 1891, Dr. Aron, realising the great advantages that would follow the use of such polyphase meters, took out patents in Germany, Great Britain and elsewhere, in which he gave very fully the theory underlying them, and also very fully described how the same principles could be applied to various types of meters so as to produce practical working instruments. It is from the patent referred to, and

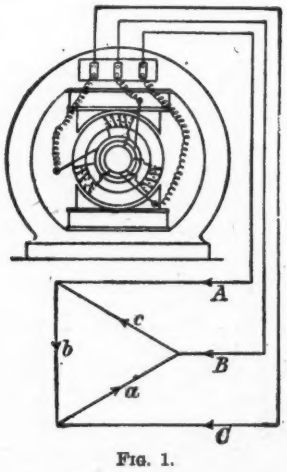


Fig. 1.

also from articles which appeared in the *Electrotechnische Zeitschrift* in 1892 and 1901, that the substance of this article is taken.

The earliest Aron meters were designed to agree with the following formula :—

$$P = \tfrac{1}{3}\{e_a(i_a - i_b) + e_\beta(i_b - i_c) + e_\gamma(i_c - i_a)\} \ldots (1)$$

in which i_a, i_b and i_c represent the currents in three mains, and e_a, e_β, e_γ represent the potential differences between them at any instant.

They contained, as is obviously necessary from the shape of the formula, six separate solenoids energised by the current, and three volt coils which were connected across the mains, and so arranged in the instrument as to be affected by the respective current coils in agreement with the formula given above. The instrument, however, was very complicated, and was not used to any great extent, as a much simpler way of obtaining the result was subsequently arrived at.

Fig. 1 shows diagrammatically a three-phase generator supplying a mesh-connected system. In this diagram a, b, c represent the currents used in the three sides of the system, and A, B, C indicate the currents being supplied to the system through the three mains; the potential difference per phase, that is, between the leads A, B, C, is represented by the letters α, β, γ, which being the case, the power being developed at any instant is :—

$$P = a\alpha + b\beta + c\gamma. \quad . \quad . \quad . \quad . \quad . \quad (2)$$

In a system such as is shown in fig. 1, the following relations will hold good :—

$$a + \beta + \gamma = 0$$
$$c - b = A$$
$$a - c = B$$

and from these four formulæ is obtained the simple relation that—

$$P = \alpha B - \beta A. \quad . \quad . \quad . \quad . \quad . \quad (3)$$

This formula being correct for any instant of time, the integral over any stated period will give the true value of the energy developed in the system during that period. Fig. 2 shows diagrammatically how this formula is applied in practice to Dr. Aron's well-known clock meter, the lettering corresponding with that in fig. 1, in addition to

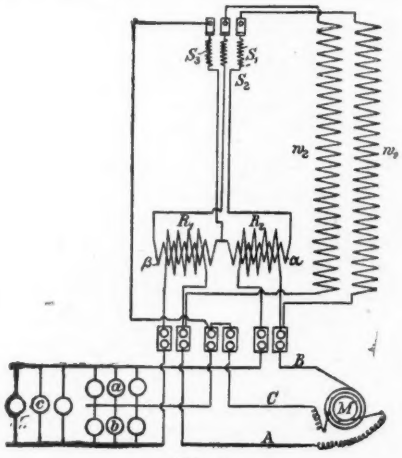


Fig. 2.

which R_1 and R_2 represent the main current coils, β and α indicating the coils fixed to the pendulums. It can be seen from the diagram that the conditions of the formula are exactly fulfilled. Over 50 meters constructed on this principle were used as long ago as November, 1891, the first meters being installed at the Lauffen-Heilbronn power station.

In his British Patent No. 21,354 of 1891, Dr. Aron shows how the same principle may be applied in the case of motor and other types of meters. He also shows a mechanical means of combining the readings of two separate meters, the mechanism employed being the same as the differential gear, which is used in all his clock meters to give an indication on one set of dials of the difference in speed between two moving systems.

The further development of polyphase working brought with it other systems of connections than that already dealt with; in many central stations three-phase systems with four conductors were installed, so that the conditions for which the meters already described were designed no longer existed. These conditions were that the algebraical sum of the currents in the three branches should be equal to nothing, or

$$A + B + C = 0.$$

Fig. 3 shows diagrammatically a three-phase circuit with combined star and mesh connections and a fourth conductor. The letters in the diagram signify :—

i_1, i_2, i_3, the currents in the mesh ;

E_1, E_2, E_3, voltages across the corners of the mesh ;

a, b, c, the currents in the star connection inside the mesh ;

e_1, e_2, e_3, the voltages between the middle point and the corners of the mesh ;

A, B, C, D, the currents in the supply mains and the fourth conductor respectively.

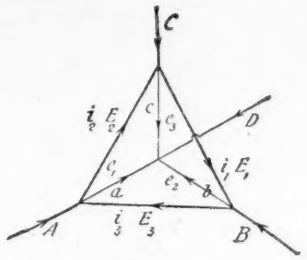


Fig 3.

The whole power, P, developed in such a circuit is—

$$P = i_1 E_1 + i_2 E_2 + i_3 E_3 + a e_1 + b e_2 + c e_3 \ldots (4)$$

also

$$E_1 = e_3 - e_2. \quad A + i_3 - a - i_2 = 0.$$
$$E_2 = e_1 - e_3. \quad b + i_3 - i_1 = B.$$
$$E_3 = e_2 - e_1. \quad c + i_1 - i_2 = C.$$

By substituting these values in (4) and simplifying, it can be shown that—

$$P = A e_1 + B e_2 + C e_3 \ldots \ldots \ldots (5)$$

This result is identical with that obtained when considering the plain mesh connection or the star arrangement with three conductors only. It has been shown, however, that

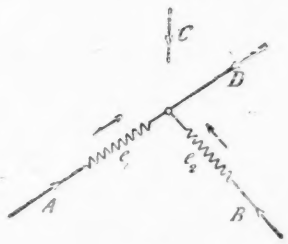


Fig. 4.

this relation is equally true for the combined star and mesh-connected circuit with a fourth wire, whether the load in the various branches is balanced or not.

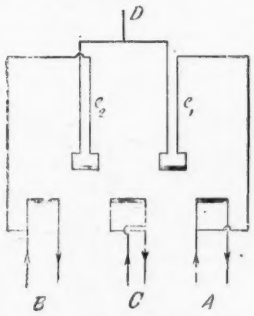


Fig 5

By substituting in (5) values obtained from the equation—

$$e_1 + e_2 + e_3 = 0,$$

we obtain the following formula for the power being developed in the circuit at any instant—

$$P = (A - C) e_1 + (B - C) e_2 \ldots \ldots (6)$$

This last can also be written—

$$P = A e_1 + B e_2 - C (e_1 + e_2) \ldots \ldots (7)$$

These formulæ lend themselves readily to the construction of meters of the clockwork type. If we consider a circuit such as is shown diagrammatically in fig. 4, the arrangement of the meter will be in accordance with fig. 5, from which it can be seen that there are three main coils carrying the currents of the three conductors A, B and C, and that swinging directly above the spaces between these coils, are two pendulums carrying shunt coils, the one under the influence

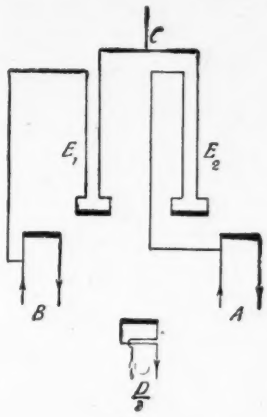


Fig. 6.

of the C oils A and C being energised by the potential difference e_1, while that under the influence of B and C is connected to the potential difference e_2. The coil C will, as can easily be seen, affect both pendulums.

Magnetically, the two shunt coils are connected up each in a sense opposite to the other, the coils A and B both in the same sense, while the coil C, which affects both shunt coils, is connected in a sense opposite to A and B. Very

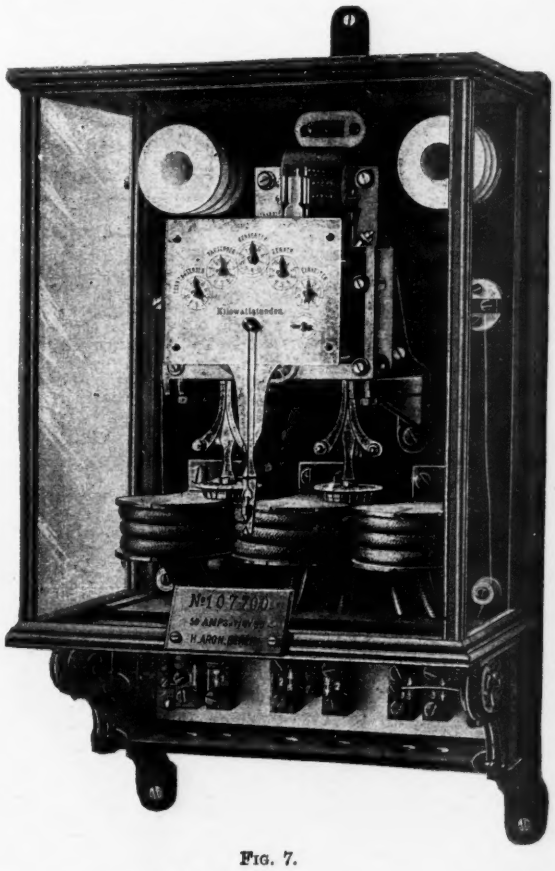


Fig. 7.

little consideration will show that such an arrangement agrees with the formulæ given above.

In many cases it may be difficult, owing to considerations of space, so to arrange the three current coils that they affect the pendulums equally, as is required by the conditions of the formulæ. In such cases, it is much better to be able to

place the middle coil at a greater distance from the pendulums, as shown diagrammatically in fig. 6, when the connections of the meter will be different, the middle coil now carrying the currents in the fourth conductor, D.

That a meter so arranged will give correctly the energy in a three-phase circuit with four conductors is shown as follows:—

Referring back to our original diagram (fig. 3), it can be shown that—

$$P = A E_2 - B E_1 - \frac{D}{3}(E_1 - E_2) \quad . \quad . \quad . \quad (8)$$

The first part of this equation is identical with that representing the whole power in a three-phase circuit with three conductors only, the term $\frac{D}{3}(E_1 - E_2)$ representing the effect of the out-of-balance current carried by the fourth conductor D.

The reason for placing the third coil carrying the current D at a greater distance from the pendulums is now obvious, as the effect of this coil must be so adjusted as to represent only one-third of the current strength in D.

It must be borne in mind that in the construction of any of these meters, each of the main current coils must be adjusted separately to give its requisite effect on the shunt coils, in accordance with the conditions of the equation. Fig. 7 shows one of the meters complete.

THE CONVERSION OF A TELEPHONE EXCHANGE FROM THE MAGNETO TO THE CENTRAL BATTERY SYSTEM.

By B. S. COHEN.

(*Concluded from page* 376.)

We must now consider the work to be carried out by the instrument fitting department. As a temporary measure, in order to enable the existing instruments to work with both the old and new systems, a condenser of 2 mfd. capacity is inserted in series with the subscriber's bell, so that when the telephone is in the normal position the bell and condenser are across the loop. In most cases the condensers can be fitted in the battery boxes. No other modification is necessary in the circuits of the instruments, but as the receiver and secondary of the induction coil will close the loop during conversation, the former must be so arranged that the current from the central battery will produce a magnetic field in the same direction as that of the permanent magnet. If the receiver is connected up in such a manner that the field set up by the current from the central battery opposes that of the permanent magnet, the hearing will be faint. When the instrument fitter is inserting the condensers, he tests for this with the testing clerk at the exchange, who puts current in the proper direction on the line.

Condensers are also inserted in series with all bells or indicators in connection with switching apparatus of any description fitted at the subscribers' offices. The instruments are now capable of working on both the old and new systems, and after the change-over has taken place they can be replaced by new central battery instruments. The methods of working a number of extension and exchange lines on the central battery system at a subscriber's office are many and varied, in order to give the facilities for secrecy and intercommunication which are demanded in this country. Special leads are run from the central exchange to the subscribers' branch switchboards, to supply the power necessary for both speaking and signalling between the extensions, private lines, &c.

Whilst the conversion of the system is in progress, the lines are repeatedly tested from the new exchange as they are connected up to the main frame. With the voltmeter method of testing adopted, this work is carried out with ease and rapidity, and the test clerk can in a few seconds determine the insulation and copper resistance of any line.

A maximum copper and minimum insulation resistance is fixed for both subscribers' and junction lines, and the exchange relays are adjusted in order to operate through the maximum copper resistance with a sufficient factor of safety and to release with a resistance well below the minimum insulation resistance. When adjusting the relays, the maximum working current is also passed through them in order to allow for the effects of residual magnetism. The traffic department has to furnish lists showing how the subscribers' and junction lines are to be distributed on the switchboard. This is obtained from the records of calls per individual subscriber and calls per operator's position in the old exchange. A curve should be plotted showing the calls per operator's position per busiest hour, and an average line drawn with maximum and minimum lines at 10 per cent. above and below this respectively. The distributing lists are then so arranged that the load curve lies between the 10 per cent. limits. Fig. 7 shows a portion of such a load curve before the distribution, but with the 10 per cent. maximum and minimum drawn.

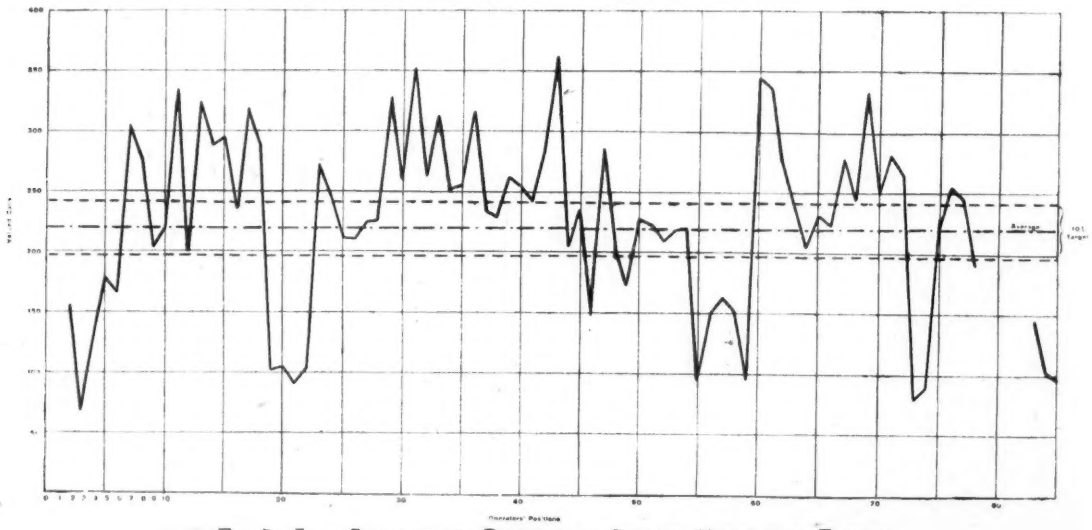


Fig. 7.—Load Curve before Distribution, Showing 10 per cent. Target.

Fig. 8 shows a portion of a load curve at Holborn exchange, and in addition the discharge curve for the same period taken from the recording ammeter. The calls are recorded every half-hour, and this probably accounts for the apparent lag between the two curves.

The exchange instrument modifications and outside system having been completed, the change-over can take place immediately after a complete test of the whole system has been carried out.

Owing to the large number and complex nature of the

circuits and the amount of apparatus, considerable time must be allowed for the final testing in a large exchange.

First comes the testing of the multiple jacks. In the new London Wall Exchange of the National Co., which has just been opened, there are a total of 681,500 jacks connected with the subscribers and outgoing junctions; each of these jacks is provided with three connections, the two lines and the engaged test, and each jack must be tested for disconnection, reversal of the three wires on the one jack or transposition with the wires on another jack, and for contact. Test boxes are generally provided for this purpose, fitted with plugs and cords which can be inserted in the corresponding jacks at any part of the multiple, and relays and lamps so arranged that reversals, contacts, &c., will be indicated by lamps glowing. In order to obviate the liability to personal error in this test, and to increase the speed of test, an automatic arrangement provided with a form of Morse inker has been used.

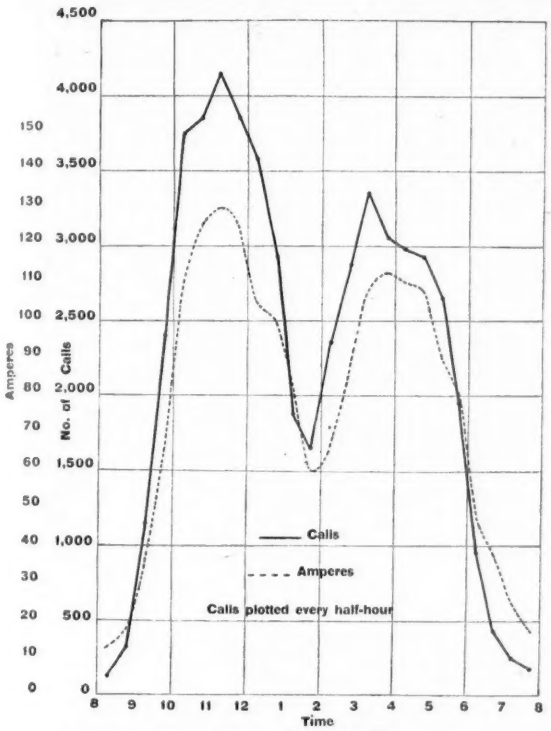


Fig. 8.—Load Curve, Holborn Exchange.

The testing of the various circuits and the relays in conjunction with them is carried out by means of test sets equipped with relays, lamps and resistance coils arranged to allow the maximum and minimum currents to flow through the circuits under test.

The tests of the charging and ringing machines, besides including the usual tests for efficiency, temperature-rise, &c., include a test for disturbances set up by the commutation, the charging machines having to take a varying exchange load direct without the cells in circuit, and without the introduction of any serious disturbances on the lines.

The internal resistance of the battery is also taken and a test for cross talk made. Besides these tests, a proportion of the deliveries of all apparatus, such as plugs and jacks, relays, heat coils, fuses, lamps and keys are tested, both mechanically and electrically, in the test rooms at the headquarters of the telephone company to whom the exchange belongs, and the remainder of the apparatus examined and passed by the clerk of the works, who is stationed at the exchange which is under construction, before it is allowed to be fitted up.

When all the faults discovered during the testing are rectified, a certificate of completion can be signed by the engineers responsible for the various branches of the work.

The change-over can now take place. This is usually carried out at the week end. To consider an actual case, it is assumed that the looping-in system has been adopted (see fig. 6), and that the time for changing over, say 4 o'clock Saturday afternoon, has arrived.

Men are stationed at the old exchange test board by the temporary jacks C, in order to pull out the wooden pegs, and others at the ordinary test jacks with a supply of wooden pegs to insert in them and thus disconnect the old exchange.

At the new exchange, arrangement has been made to cut off the temporary cross-connections, and the heat coils have already been inserted in the arresters (these completing the connection between the inside and outside lines). Previous to this, however, the covers have been removed from the working line and cut-off relays and slips of thin insulating material inserted between the contacts of the cut-off relays. By this means the line apparatus is kept disconnected from the lines until the first insertion of the plugs into the jacks, when the actuation of the cut-off relays releases the insulating slips, which fall to the floor.

All the operators are in attendance, the majority at their positions in the new exchange, only sufficient being left at the old exchange to take the normal Saturday afternoon load, which is generally small. The operators in attendance at the new exchange will not find their surroundings entirely novel, as they have spent some time, in detachments of two or three, at the new board, familiarising themselves with the multiple and the location of the various junction lines, order wire keys, &c., under the guidance of a senior operator or instructress from an operating school, if such exists. The actual change-over takes a surprisingly short time, even in a large exchange.

It is customary to provide the operators attending at the new exchange with lists of numbers which can generally be obtained during the slack time, such as hospitals, fire and police stations, and other public institutions, also doctors. These lines can be tried directly the change-over takes place, and the remaining lines on the first normal day.

I must express my indebtedness to the National Telephone Co., Ltd, for much of the information embodied in this article.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Localisation of Faults on Cables.

There is one point I should like to draw your attention to in "Contributed's" article on "Localisation of Faults."

In his first example, having measured the resistance of the faulty cable from each end to the fault, the figures being ·793 ohm and ·08 ohm respectively, and the length 1,000 ft., he works out the result thus— $\frac{1{,}000 \times \cdot08}{\cdot793} =$ 100 ft. Surely this should be— $\frac{1{,}000 \times \cdot08}{\cdot793 + \cdot08} = 91{\cdot}5$ ft., making the considerable error of 8·5 ft. This evidently is not a "slip," but an error in method, as he repeats the same mistake in his other example.

Fault-Finder.

Rotary Converters.

Transformers supplying current to rotary converters are usually connected in mesh, so that in the event of a fault occurring on any one of the transformers, it may be switched out and the machine run on the remaining two until the necessary repairs have been carried out. If, however, there is more than one transformer on each phase, as in the case mentioned by Balderstone, it is obvious that any one may be switched out, no matter in what fashion they are connected. There is but little doubt that the statement—transformers supplying current to rotary converters which are never parallel on the three-phase side—applies simply to this one case, namely, when the secondaries are entirely independent from the secondaries of transformers belonging to other machines.

E. Austin.

London, W., *March 7th*, 1905.

A.C v. D.C.

It is doubtless a great advantage for every man to believe that the particular system of generation and distribution of electricity with which he is connected is absolutely the best. But, speaking as one who has had both D.C. and A.C. experience, and who is now on three-phase work, I think that Mr. W. Talboys Wheeler is rather over-rating the extraordinary amount of difficulty an A.C. system presents, also the immense amount of ability that is required to surmount its inherent cussedness.

Extraordinary as it may seem, on some supply systems the volts have actually to be kept near the declared pressure, and it is not necessary, on most D.C. supplies, for the mains assistant to go round to new consumers with a voltmeter before declaring the pressure the consumer has to be supplied at, as is commonly reported to be the custom on some single-phase A.C. systems, as doubtless Mr. Wheeler knows.

When I was a poor little D.C. man, I used to have some of the great respect for the H.T. A.C. man, which Mr. Wheeler evidently thinks is due to him; but it has been modified to such an extent that it no longer exists.

A more ridiculously simple system of supply than the single-phase A.C. one, with the outer earthed and a two-wire distribution, it would be difficult to imagine.

The synchronising, which frightens most D.C. men before they know how to do it, is, after all, only a fairly easy gymnastic performance quickly picked up, though, doubtless, Ferranti coreless machines are harder to get in satisfactorily than ordinary three-phase generators.

Rectifiers are not nearly such awful instruments as they seem to an unsophisticated D.C. man when he first makes their acquaintance.

Of course an A.C. man is better than a D.C. man in an A.C. capacity, but a D.C. man would be far less liable to make a hash of an A.C. job, than an A.C. man to do so on a D.C. job; D.C. men have a wholesome respect for H.T. work, but A.C. men are likely to under-rate the damage which a D.C. low-tension supply will do if it gets the chance.

I almost might sign myself to this letter as re-converted direct-currentite.

Balderstone, A.I.E.E.

The absurdity of Mr. Wheeler's contention, that a purely A.C. man is competent to run any D.C. station, is patent to all men of any experience of D.C. work. For my own part I must say that from the way modern alternating current systems are laid out for operation they are certainly simpler than any three-wire D.C. system; this stands good for both single and polyphase stations.

When Mr. Wheeler attains the dignity of a chief engineer, his tendency will not lead him to place purely A.C. men in charge of D.C. stations, unless he sleeps on the premises, and I should strongly advise him to have his rooms as far away from the plant as possible, for if a fire occurred and his apartments were included in the station buildings, his faith in the purely A.C. man would be rudely shaken by the latter's advent in a D.C. three-wire station, and by the inevitable "flare-up," which would also cause him personal inconvenience.

Then, again, as for A.C. experience being the higher grade of the two, may I suggest that the reason for this is, that the largest stations are worked on the A.C. principle (chiefly for transmission and other obvious purposes), and as the aims of station assistants are in the direction of large undertakings, apparently the qualities have become confused with the quantities in this case.

T. B. C.

Stalybridge.

Permit me to pen a few words in opposition to Mr. Wheeler's views on the A.C. *versus* D.C. problem. Mr. Wheeler asserts that the A.C. is the higher grade. Undoubtedly this is so if grade = E.M.F. Then, grade = E.M.F. = truth on the A.C. side. But battery, boosters, balancers, &c., which are plus on the D.C. side, tend to form complications and restore the grade of the latter.

Having constructed several large stations on both systems, I would like Mr. Wheeler to note that I, along with others, prefer an A.C. plant for an easy job. What is there in an A.C. station beyond the machines and exciters? Switchgear is practically an absentee beyond massive protection for switches and fuses, such as exist (not forgetting the rubber gloves which help to adorn an A.C. board). The noble art of synchronising (a glorious word for A.C. men) is fully compensated for in D.C. work by the unassuming "paralleling." Granted the A.C. man has no battery as a peak load assistant, consequently no trouble to charge it.

The words "three-phase 30,000" volts have undoubtedly a disastrous effect on the nerves of some weak-minded D.C. assistants, but, in my mind, if they are conversant with their own plant they need never be afraid of an alternating system, only their motto ought to be "Please keep off the brass."

J. E. C.

Conduit v. Casing.

Mr. Lackie's interesting paper on earthing, an abstract of which appears in your issue of 17th ult., incidentally throws a strong sidelight on the "Conduit *v.* Wood-casing" controversy. He mentions that out of the 33 electrical fires reported to the Glasgow Corporation during the past three years, 15 were directly due to defects in the metal conduit system. Of the remaining 18, some were apparently due to the same cause, some to defective fittings, &c., and two only to wood-casing, *per se*. When consumers and fire insurance people realise a few interesting facts like these, their cry will be (in Yorkshire, anyhow):—"Steel conduit be doomed!"

Megohms.

A Chief's Complaint.

In view of the many complaints which appear in the Press from time to time, as to the undignified treatment of municipal engineers at the hands of Committees, &c., I think it is quite time the Municipal Electrical Association should form a Union in connection with their Association, to protect not only the chief engineers but all assistant engineers. By this means, I think, the conditions of assistants would be improved, and they could then demand at least a living wage, while such an undignified request as forms the subject of "Chief Engineer's" complaint would be so strongly resented by this body, that the offending Committee or Council would at once withdraw the cause of the complaint, or else the Union would have the town boycotted by all its members.

Another Chief.

March 4th, 1905.

On Dumping.

Your correspondent, Mr. Arnold Maude, appears to imagine that he has solved the fiscal problem when he makes the startling discovery that an all round protective duty tends to decrease the purchasing power of money.

The blandness of the statement clearly shows that he is a novice, pure and simple, as far as economies are concerned. He would be well advised if, in the future, he kept all such discoveries to himself, and practised approaching the subject not from the standpoint of a demonstrator but as a student. If he desires to retard the fiscal reformation as a disciple of the "unambiguous," the most effective way of doing this is to say nothing at all about it, as discussion simply accentuates investigation, which in turn diffuses facts and truths and discards theories, leaving the investigator in a frame of mind which cannot be affected by the recital of cob-webbed ideas and old-world platitudes.

Mr. Maude might, however, find a clear path out of his difficulties if he tried to find out why all the Protectionist countries are so anxious that Britain should not alter its tariff arrangements, why so much land is being put out of cultivation in this country, and why one person in every 40 in Free-Trade Britain is a pauper, when the proportion in France and the United States is 1 in 260 and 1 in 250 respectively.

Veritas Vincit.

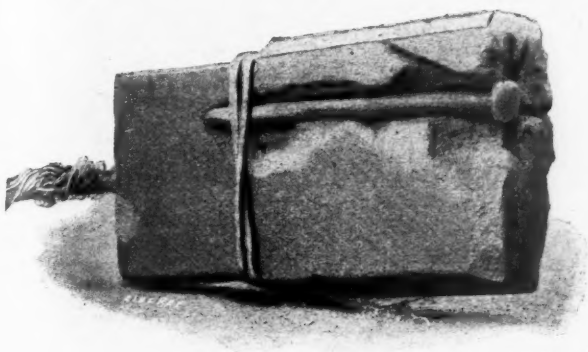
[Legal Query.—No Name. If "Pledger" who sends us a legal query will forward his name and address, his query will be answered.—Eds. E.R.]

A South African Experience.

I am enclosing two photos which I think may interest your readers, and which go well to illustrate the saying "it is always the unexpected which happens."

The smaller photo shows a carbon brush belonging to a 15-H.P. 500-volt D.C. motor, which drives, by belt, part of the shafting in the Natal Mercury Printing Works, here in Durban.

One night last week the motor, which had been running perfectly satisfactorily for some time, started sparking very

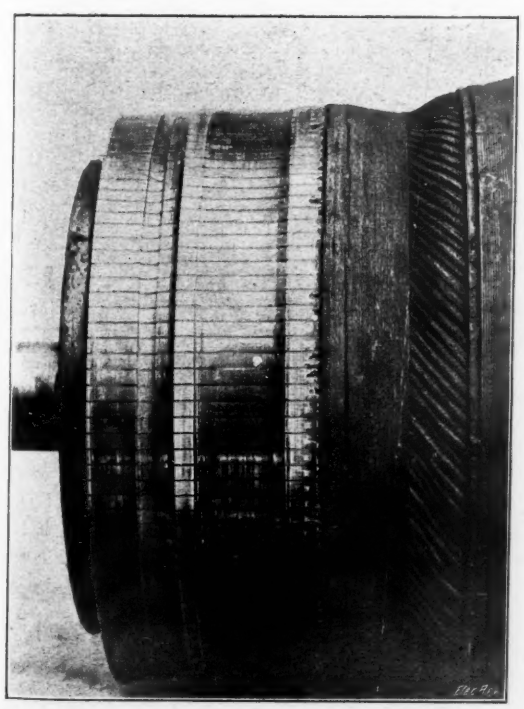


French Nail in Carbon Brush.

badly, and, on inspection, the commutator presented an appearance as shown in the large photo.

On removing the brushes I found that one of them had, what looked like a piece of copper sticking to it, which had cut the commutator badly.

On placing a fresh brush in the machine it was possible to start up again, and the machine ran for nearly a week,



Damaged Commutator.

day and night. When the commutator was turned up it was found necessary to turn off nearly $\frac{3}{8}$ in., so as to remove the groove. On cutting open the brush I discovered the trouble was due to a "2 in. French nail," which was buried in the carbon and had only become visible on account of the brush wearing down till the head came in contact with the commutator. The head of the nail had become plated with copper all over, owing to the heat, no doubt. The machine and brushes are examined every day and nothing was wrong then. The copper turnings were scattered all round the motor, showing how quickly the damage had been done.

I should be obliged if any of your readers could quote any similiar experience, as, if so, it will be necessary in ordering brushes to state that they must be free from all nails or other foreign substances.

Henry D. Waldram.
Manager, Heywood & Co., Electrical Engineers.

Durban, South Africa,
February 7th, 1905.

Electricity v. Gas.

Being a regular reader of your paper I was much surprised by the article in last week's issue headed "The Lighting of Buildings, &c., by Electricity and Incandescent Gas." How any men in their right minds can compare gas lighting to electric lighting is, and always has been, a mystery to me. The lighting of town streets by incandescent gas is a miserable failure, and strong winds play havoc with the mantles.

Most of the streets of this city are lighted in this way, and at night (when the shops are closed) present a very gloomy appearance. Returning here the other evening from Leeds (which as you know is brilliantly lighted by arcs on every trolley standard), I was struck with the dismal and ghastly light in the streets illuminated by incandescent gas.

William Hugill.

Bradford, *March 2nd*, 1905.

[It is quite true, as our correspondent (who is a wool broker, and therefore quite unbiassed), remarks that the lighting of Bradford is a disgrace to that great industrial centre, while the lighting of Leeds is excellent. We speak from personal knowledge.—Eds. E.R.]

LEGAL.

Thomas *v.* Mackie & Co.

This case came before the Court of Appeal, composed of the Master of the Rolls and Lord Justices Mathew and Cozens-Hardy, on 28th ult., on the defendants' application for judgement or new trial in an action tried before Mr. Justice Lawrance and a common jury in the King's Bench Division.

The action was brought by the plaintiff to recover damages for personal injuries, owing to the alleged negligence of a servant of the defendants. The facts were shortly these:—The plaintiff was in the employment of Messrs. Mann & Crossman, the brewers of Mile End Road, and his duty was to attend to a lift for raising barrels of beer from the vaults into a room called the staging, from which they were loaded on to the carts for delivery to customers. There were two vaults, one below the other, and the lift consisted of a band with prongs upon it at intervals upon which the barrels were placed when they were to be raised. There was a pit 3 or 4 ft. deep at the bottom of the lift. The defendants, a firm of electrical engineers, had previously put up electric motors for working the lift from the upper vault, and in February, 1904, they were employed by Messrs. Mann & Crossman to lay the wires for working the lift from the lower vault, and defendants sent two of their men to lay the wires, and a foreman. After the wires had been laid and the connections made on February 6th, one of the wiremen in starting the lift for the purpose of explaining to the plaintiff how something was to be done on an emergency, fused the wire. On February 8th he repaired the wire and started the lift to see if it worked properly, when it struck the plaintiff, who was in the pit clearing out some rubbish. Plaintiff's case was that the lift was started without any warning. The defendants' case was that the wireman was expressly directed not to touch the machinery or put the lift in motion, and that he was to call the second engineer of the brewery when the work was finished, in order to set the machinery in motion for the purpose of testing the wires and connections. Defendants contended they were not liable on the following grounds:—(1) That the wireman in setting the machinery in motion was not acting within the scope of his employment; (2) that even if he was, the defendants were not guilty of negligence, as their servant gave a warning shout before setting the machinery in motion; and (3) that the plaintiff had been guilty of contributory negligence. At the trial the jury awarded the plaintiff £80 damages, and judgement was entered accordingly. (See Elec Rev, Nov. 18th, 1904.) Hence the present application of the defendants on the ground that the verdict was against the weight of the evidence.

Mr. R. J. N. Neville appeared for the appellants; and Mr. W. M. Thompson and Mr. J. D. A. Johnson for the respondent on the appeal.

In the result, their Lordships allowed the appeal, holding that the act of the defendants' wireman which caused the accident, was done outside the scope of his employment, and therefore not as the defendants' servant. They accordingly allowed the appeal, and entered judgement for the defendants with costs.

Beale *v.* William Griffiths & Co., Ltd.

On Friday last the hearing of this case was concluded in the King's Bench Division before Mr. Justice Lawrance and a special jury, the action being brought by the plaintiff, a fishshop proprietor, against the defendants for personal injuries sustained through the alleged negligence of the defendants.

The facts were these:—The plaintiff, on the night of November 10th, 1903, was driving a pony and barrow along the Borough Road, when one of the wheels skidded along a raised tram rail temporarily placed in the road by the defendants, who were carrying out a contract with the L.C.C. for the electrification of the tramway system in South London. The barrow was upset, and the plaintiff sustained serious injuries. The evidence was that the rail was put down temporarily to carry the trams while that particular section was under reconstruction; that the bolts, clips, and fastenings of the rail were loose, and some of them out; that there were no feather-edged boards at the place where the accident happened; and that the rail was uneven, being raised at places by the crossties about half an inch from the granite setts in the road.

The defence was that the temporary tramlines had been laid down after the most approved method, and that a similar process had been adopted all over the metropolis.

In the result the jury awarded the plaintiff £860 damages, and judgement was entered accordingly.

Mr. Clavell Salter, K.C., and Mr. Clarke Hall appeared for the plaintiff; and Mr. McCall, K.C., and Mr. J. D. Crawford for the defendants.

Electric Tramways Construction and Maintenance Co., Ltd.

In the Chancery Division of the High Court of Justice, on Tuesday last, Mr. Justice Buckley in this case had before him the petition of Mr. A. J. Paine for the winding up of the company.

Mr. Norton, K.C., for the petitioner, said that the petition had stood over from an action to be tried before Mr. Justice Kekewich. The action had been tried, and the result was that the company was now in voluntary liquidation. Under these circumstances, he desired to withdraw his petition, without costs.

Counsel for the company agreed to the course proposed, and counsel for creditors, who appeared in support of a winding-up order, said he was not in a position to say his clients would be prejudiced by the voluntary winding up.

His Lordship asked when the company went into voluntary liquidation.

Mr. Norton, K.C., said immediately after the conviction of Mr. Lawson at the Old Bailey.

His Lordship then dismissed the petition, without costs, and made the same order with regard to a summons to stay proceedings and a summons to expunge a paragraph from an affidavit.

Electric Trades Supply Co. *v.* Hinds Bros.

In the King's Bench Court at Dublin last week, plaintiffs, a company carrying on business in Manchester for the supply of electrical fittings, sued defendants, who carry on business in Belfast, for £75, the value of electrical fittings entrusted to them as agents, and for damages for their detention. Defendants' claim a lien on the goods in respect of commission, for which they counterclaim. Mr. Andrews (instructed by Messrs. Johns, Bates & Johns), for plaintiffs, applied for discovery of documents. Mr. Hanna (instructed by Mr. George Allen) applied for a cross order. Mr. Justice Boyd granted both orders.

PARLIAMENTARY.

Medway and Thames Canal Bill.—The promoters have given notice of their intention not to proceed further with this Bill, which sought to empower the Medway and Thames Canal Co. to purchase the existing canal belonging to the South-Eastern Railway Co., and adapt it to be worked by electric traction.

Glasgow Corporation Tramways (Consolidation) Bill.—This Bill which comes under the Private Legislation Procedure (Scotland) Act, came before the Examiner on Thursday last week, and it was found that Standing Orders had not been complied with. Application will accordingly have to be made to the Standing Orders Committee for leave to proceed with the Bill.

Oldham and Saddleworth District Tramways Bill.—The Chairman of Committees of the House of Lords has been informed that the opposition to this Bill has been withdrawn.

Standing Orders.—The Examiner on Monday found that Standing Orders had been complied with in the case of the South Wales Electrical Power Distribution Bill. On Tuesday, the Wellingborough and District Tramways and Electricity Bill, and the Paisley District Tramways Bill, passed the Standing Orders stage.

The Andover Lighting and Power Bill, the Shropshire and Worcestershire Electric Power Bill, and the South Wales Power Distribution Co. Bill have been referred to a Select Committee of the House of Commons to be dealt with.

Hammersmith, City and North-East London Railway Bill.—This Bill came before the Standing Orders Committee of the House of Commons on Tuesday, when the promoters asked that Standing Orders might be dispensed with, and the Bill be allowed to proceed. There were several proofs of non-compliance, but the most important was the failure on the part of the promoters to deposit a certain proportion of the proposed capital. After consideration, the Committee decided that Standing Orders should not be dispensed with, and the Bill will accordingly be dropped this session. The project was to construct a tube railway from Hammersmith to the City, and from the City to Walthamstow and Palmer's Green. The line would have been about 20 miles in length, and the proposed capital of the company was £7,200,000.

Shropshire and Worcestershire Electric Power Bill.—On Tuesday last the Court of Referees sat to consider the *locus standi* of the petitioners against a number of the Private Bills. Among the Bills dealt with was that of the Shropshire and Worcestershire Electric Power Co., the petitioners against which numbered five on the list. Four of them, however, were not represented, and the *locus* of the Cannock, Hednesford and District Gas Co., Ltd., was considered.

Mr. Vesey Knox appeared for the petitioners. He said that the promoter's Bill was a measure which sought to confer power upon them to supply electricity in competition with the petitioners.

The Chairman, to Mr. Wedderburn (for the promoters): Your company was incorporated four years ago?

Mr. Wedderburn: No, Sir; about two years only.

The Chairman: And you have not yet done very much?

Mr. Wedderburn: No, I think not—like other power companies.

Continuing, Mr. Vesey Knox cited various cases in which it was decided that a gas company could come in and oppose an electric Bill, and said that the promoting company would be able to represent to a user that an electric motor would be cheaper than a gas engine. That would be competition, for the power could also be used for the purpose of producing light.

Mr. Wedderburn said that it was the old argument, which was produced when the power Bills first came up. There were a number of authorities in the district which already competed with the gas company.

The Court allowed the *locus*.

In the House of Commons on Tuesday the Baker Street and Waterloo Railway Bill, the Charing Cross, Euston and Hampstead Railway Bill, the Edgware and Hampstead Railway Bill, the Great Northern, Piccadilly and Brompton Railway Bill, and the London County Council (Tramways) Bill were each read a second time. The last-named is the Bill for authorising, among other things, the carrying of the tramlines over Westminster and Blackfriars Bridges and along the Embankment. The debate will take place on March 23rd.

BUSINESS NOTES.

Automatic Point Controllers.—We understand that Messrs. S. Dixon & Son, Ltd., have on hand a number of orders for the supply of Turner's patent automatic point controller. They have recently installed this apparatus on the Manchester, Rotherham and Leicester Corporation Tramways, and are at the present time fixing eight of them on the West Ham Corporation Tramways. They have also received a third repeat order from the Leeds Corporation Tramways for four controllers.

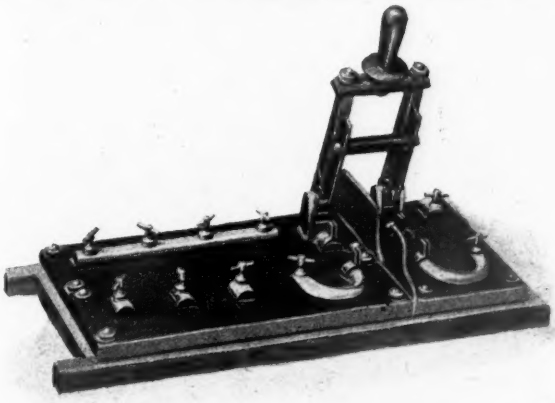
Staff Dinner.—The first annual staff dinner of the Anchor Cable Co., Ltd., Leigh, was held in the White Horse Hotel on Monday evening, February 27th, Mr. R H. Harvey, the manager, being in the chair. After dinner, songs were rendered by members of the staff, an enjoyable evening being spent.

Metropolitan Asylums Board.—At the meeting of the Metropolitan Asylums Board on Saturday last, an order was received from the Local Government Board authorising the execution of works for the purpose of lighting Belmont Asylum by electricity, and also the provision of telephones and fire alarms, at a cost not to exceed £6,540. On the recommendation of the Works Committee it was agreed to apply to the Local Government Board for sanction to the managers inviting tenders from nine selected firms for the installation of proposed systems of electric lighting, telephones and fire alarms at the Southern Hospital. The Committee stated that at the present moment the engineer-in-chief was not in a position to give a definite estimate of the cost of the proposed works, but he anticipated that the cost would be approximately £9,000, of which the underground mains alone would account for about £3,000.

Football.—On Saturday last the engineering works of the G.E. Co., Witton, sent their football team to London to play Robertson Lamp Works, and, after a somewhat exciting game, the Birmingham team ran out the winner by 5 to 2. After the game, they were invited by the Robertson Lamp Works to a tea provided by the president of the Robertson Lamp Works Club (Mr. C. Wilson), and after that a dance, which had been postponed from Wednesday was held. Mr. Wilson, in a speech, said that it was the first inter-works game that had ever taken place in the history of the G.E. Co., and he hoped it would not be the last.

Coal-Handling Plant.—Messrs. Graham, Morton and Co., have just secured the contract for the installation of an extensive boat-loading plant for Seaham Harbour

Three-Way Distributing Switchboards.—The small 50-ampere distributing switchboard illustrated below, is supplied by Messrs. Moores, Farrell & Co., of Victoria Street, Manchester. The board, which is of neat design and solid construction, is fitted with the firm's "Mynshull" type knife switch—the latter having an exceptionally long break, and two distinct off positions. The



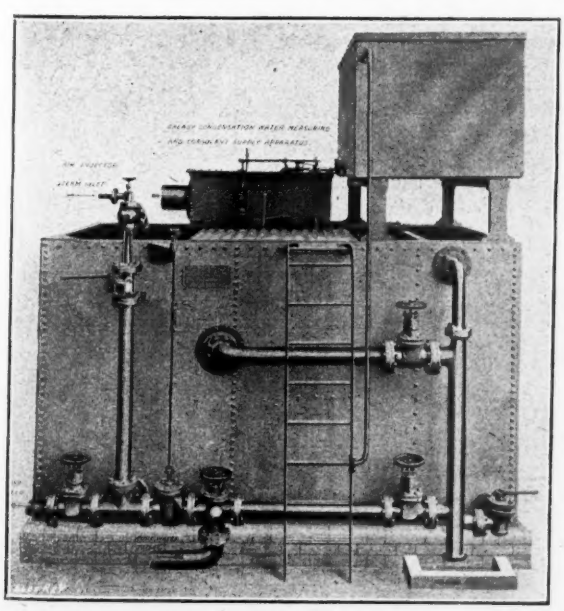
50-amp. Three-way Distributing Switchboard.

metal parts are of ample carrying capacity, and the arrangement of the leads and fuses is designed to facilitate actual operation. The bus-bars and contact pieces are of half-round copper giving an excellent finish; this type of board is specially adapted for crane and power work, and it can be built in a variety of sizes and designs.

Automatic Insulation Testing Device.—Referring to our note under this head last week, Mr. J. W. Manley writes pointing out that he is not the inventor of the device in question, though he is financially interested therein. The apparatus was invented and patented by Mr. R. J. Bott, of Tottenham, who retains a share in it.

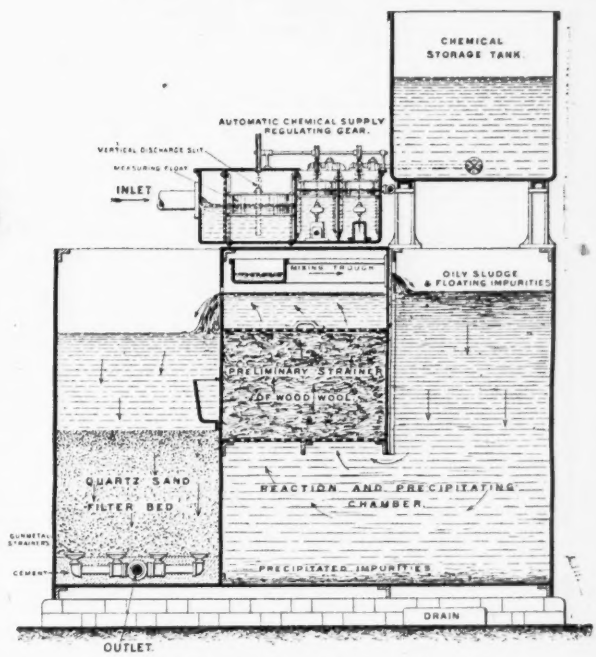
Paterson Condensation Water Purifier. — We recently published a brief description of the power plant installed at the Gibraltar Dockyards; in connection with this plant there were also installed, to the order of the Electric Construction Co. (the principal contractors), two sets of apparatus for the purification of the condensed water prior to its use for boiler feeding. These purifiers were made by the Paterson Engineering Co., Ltd., of Amberley House, Norfolk Street, W.C., and embody their latest improvements, a description of which may be of interest. The accompanying illustrations show the apparatus in elevation and section.

The greasy condensation water, after passing through a perforated baffle plate to free it from undue agitation, enters the measuring



Paterson Grease Eliminator, for Gibraltar Dockyards.

float chamber of the automatic chemical supply gear, and overflows through the vertical discharge slit or weir, shown dotted, into the mixing trough below, where it mingles with the coagulent discharged by the taper valve in the chamber adjacent to the chemical storage tank, to which this chamber is connected by a ball valve for maintaining a constant head of reagent above the valve seat. The other valve chamber may be connected to the make-up water supply, and adjusted to add from 5 per cent. to 10 per cent. make-up at this point. The bulk of the grease separates out on the surface of the water in the reaction and precipitating chamber, in the form of a thick sludge, which can be overflowed to waste when necessary. The sedimentary matter falls to the bottom, and is flushed to the drain periodically. The water is partially clarified before passing into the filter by upward straining through wood wool shavings, contained in the preliminary strainer. The filtering medium employed is a specially mined quartz silver sand (almost pure silica) resting upon a bed of fine pea gravel. The action of the coagulent



Sectional Elevation of Paterson Purifier.

is to form an exceedingly fine harmless gelatinous precipitate which seals up the interstices between the sand grains and forms an impervious barrier to the oily globules. The pure water is drawn off uniformly from the under side of the bed through a large number of gun-metal strainers, screwed into the manifold pipe system leading to the pure water outlet duct. These strainers are fitted with finely perforated renewable phosphor bronze screens. An automatic outlet controller, by throttling the outlet discharge, prevents the possibility of the filter being drained empty when running on light load. To wash the filter, the current of water is reversed through the bed and the impurities flushed over the waste gutter to the drain. This cleansing is assisted by the agitation, aeration, and sterilisation obtained by forcing air through the bed by means of the air injector. Attention is required about 10 minutes daily for re-charging the chemical storage tank, and flushing out the filter. In electric lighting stations during the summer when the load is light, the purifier may only require attention once a week.

Bankruptcy Proceedings.—Under the failure of James T. Armstrong, electrical engineer, Moorgate Station Chambers, E.C., the first meeting of creditors was held on Monday, at the London Bankruptcy Court. Mr. E. Leadam Hough, Senior Official Receiver, reported that it appeared from the debtor's statements that he commenced business 30 years ago at Liverpool, as an engineer and consulting chemist. About 10 years later he removed to London, and for the last 11 years he had carried on the business of an electrical engineer at Moorgate Station Chambers. He did not admit insolvency, being only temporarily short of ready cash. A draft statement of affairs showed unsecured liabilities £4,845, and assets valued at £11,807, or sufficient to yield a surplus of £6,962 after providing for payment of all the debts. The assets included stock of electrical fittings, lathes, forges, tools, &c., in his experimental laboratory at Hughenden; office furniture and patents; book debts and household furniture; a claim against the General International Wireless Telephone and Telegraph Co, Ltd.; and shares in various companies. Mr. Philip J. Rutland, on behalf of the debtor, asked for an adjournment. He said that, if further time were granted, his client would be able to submit an offer to the creditors, who, he confidently believed, would be paid 20s. in the £. The present position was occasioned by the action of two money-lending creditors, who, although now together claiming some £2,000, had already received almost as much as they had advanced. It was the desire of the debtor to preserve the estate with the utmost care, for the benefit not only of the creditors, but of himself. Besides a claim to nearly £6,000 against the General International Wireless Telephone and Telegraph Co, Ltd., the debtor had a large holding in that concern as a shareholder, and the effect of a receiving order would not only be the wreck of his own chances, but also be detrimental to the company. The suggestion to adjourn the meeting was at first

opposed on behalf of the cash creditors, but eventually it was resolved to postpone the proceedings until April 13th.

At the London Bankruptcy Court on March 3rd, before Mr. Registrar Brougham, the public examination of Harold Edward Parris, electrical supply factor, 134, Upper Thames Street, E.C., took place. The accounts showed gross liabilities £257, of which £215 is expected to rank against assets valued at £1 18s. In the course of his evidence, the debtor said he had traded under the style of the St. George's Electrical Manufacturing Co. He commenced in 1900 without capital at 19, Lullington Road, Anerley, his father's residence. In 1902 he opened a shop at 120, High Street, Sydenham, and in the following year he removed to 134, Upper Thames Street, where he was trading at the date of the receiving order. His present position was principally due to lack of capital. The business had been practically to execute orders obtained by advertisements in technical journals. Debtor admitted that he had been insolvent throughout his trading, and that he had never made any profit. The examination was ordered to be concluded.

Book Notices.—*The Case for Partnership Assurance.* By T. P. Wansbrough. London: C. & E. Layton, 56, Farringdon Street, E.C. 1s. 6d.—In the preface to this pamphlet, Mr. J. V. Vesey Fitzgerald, K.C., remarks that each partner in a business has an insurable interest in the other's life, because of the loss or injury likely to be suffered from the premature death of either party. Partnership deeds frequently contain elaborate clauses relating to the protection of the interests of the heirs or dependents of a deceased partner, but Mr. Wansbrough, in the course of his examination of the subject, declares these to be often inadequate or inequitable, and he says that the only method by which the rival claims can be fully safeguarded, is to adopt some form or other of insurance. He has prepared an equitable method of apportioning the premium payments amongst the several partners in such a manner that if any partner refuses to maintain any policy in force, it is entirely his own interests which suffer. The proposed solution is adaptable to the most complicated cases.

"Practical Methods of Electro-Chemistry." By F. Mollwo Perkin. London: Longmans, Green & Co. 6s. net.

"The Marienfelde-Zossen High-Speed Electric Railway Trials." By Dr. A. Gradenwitz. From the Smithsonian Report for 1903.

"Technology Quarterly," December, 1904. Boston: Massachusetts Institute of Technology.

The Brush Electrical Engineering Co., Ltd., has sent us a copy of Hazell's Annual for 1905, in strong and pleasing Brush binding, with gilt edges. This is a very acceptable and effective way of keeping the Brush Co. and its standard electric specialities constantly in mind during the current year, for *Hazell's* is a very widely used reference work.

Street's Newspaper Directory (8, Serle Street, W.C., 3s. 6d.) for 1905, calls for little comment beyond the mere announcement that it has been published. A large newspaper map of England and Wales is given, and it is easy to find out the names and addresses and a few general particulars of newspapers, magazines and other publications appearing in London and the provinces. A selected list of Colonial and foreign newspapers also appears.

From the British Thomson-Houston Co., Ltd., we have received a fully-illustrated account of the electrification of the Metropolitan District Railway reprinted from the *Tramway and Railway World*

Electrics.—Vol. I., No. 1, March, 1905. The official publication of the South Wales Electrical Power Distribution Co., Cardiff. 2d.

New "Twinkling Socket" for Electric Signs.—The Electrical Co., Ltd., 121—125, Charing Cross Road, W.C., has lately put on the market a special socket, designed for electric sign work, which obviates the necessity for employing expensive automatic switcher, and thus reduces the first cost of such advertising devices. This special socket can be fixed into an ordinary lampholder, and can be used for incandescent lamps of 10 or 16 c.p., and 110 or 220 volts. The socket is designed so that when the current is switched on, each lamp is cut in and out quickly and continuously at equal intervals. If the complete sign is fitted with a number of these special sockets, a most effective result is obtained, as the whole sign appears to be twinkling or flickering.

Catalogues and Lists.—The C. W. Hunt Co., Staten Island, New York, has sent us a little booklet illustrating rolling stock, &c., for light contractors and mining railways; also a gummed sheet of engineering data for insertion in pocket-book.

From Messrs. Norton & Gregory, Ltd., Castle Lanes, Buckingham Gate, S.W., we have received a booklet dealing with their drawing offices, &c.

A pamphlet has come to hand from Pulman Patents Co., Ltd., 120, Marylebone Lane, Oxford Street, W., describing their patent detachable-leaf system of binding correspondence, &c.

The Imperial Engineering Supplies Co., Ltd., Parliament Mansions, Victoria Street, S.W., have sent us a list describing joint boxes for distributors, &c., fuse boxes, manhole covers and frames, section pillars for E.L. and traction, and transformers, the manufactures of Messrs. David Sowden & Sons, of Shipley. The former firm have been appointed sole agents for Messrs. Sowden south of Derby. The various mains accessories detailed in the list are well illustrated.

We have received from the Western Electric Co., of 171, Queen Victoria Street, and North Woolwich, a catalogue of their "American" electric railway supplies for 1905. It is bound in cloth, profusely illustrated, and should be of interest to all traction engineers.

Messrs. J. S. Henry Ltd., 287—291, Old Street, E.C., have sent us a booklet giving a few "Press" opinions on their wooden electric light fittings, and mention that they are publishing an "Edition de Luxe" catalogue of their manufactures. It is too costly for indiscriminate distribution, and they solicit inquiries for copies.

A copy of a pamphlet describing the Taylor-Newbold cold-steel cutting saw has come to hand from Messrs. E. E. Clark & Co., 49, Deansgate, Manchester, who are the sole agents in this country for the manufacturers, the Tabor Manufacturing Co., Philadelphia, Pa. Messrs. Clark & Co. also call attention to an improved air lift system for raising water from artesian wells, a working model of which can be seen at their offices.

Messrs. G. Clark & Sons, Ltd, Shipley, Yorks, have sent us a new and well got up catalogue of their joint and disconnecting boxes and fittings, feeder pillars, &c. Many of the company's productions are described and illustrated, and a drawing showing the system for the distribution of triple-concentric mains is also included. The book is cloth bound.

We have received from Messrs. Davies, Kent & Stewart, Ltd, 17, Berners Street, Oxford Street, W., a comprehensive catalogue of their electrical accessories, for lighting and bell work, fans, wires, &c.

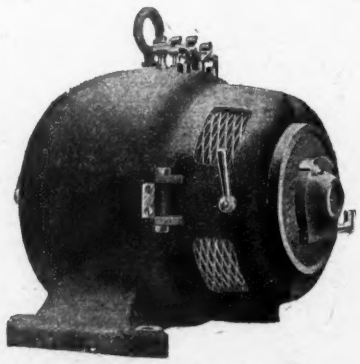
The Simpson Automatics, Ltd., 39a, South Castle Street, Liverpool, have sent us leaflets dealing with their "Duplex" fire alarm. It consists of an instrument operated by expansion tubes closing an electrical circuit; it has a double signalling arrangement, one alarm, say, at 30° above normal summer or winter temperatures, suiting the case of quick fire, and a second signal acting at 120° or any higher desired temperature in the event of a slow smouldering fire. The hydraulic principle has been adopted; hollow thin tubes, each about 6 ft. in length, are placed under the cornice or ceiling, the tubes containing a sensitive liquid readily expanding with heat, the duplex action being carried at the end.

Messrs. R. & J. Rankin, of Union Foundry, Manchester Street, Liverpool, have sent us a leaflet illustrating several of their specialities, including gear and pulley wheels, clutches, pipe wrenches, valve reseating machines, &c.

The Electrical Co., Ltd., 121-125, Charing Cross Road, W.C., have placed before us their latest Nernst lamp pamphlet, which shows a number of recent productions. A new multiple type Nernst lamp, consisting of three large Nernst lamps, all enclosed in one fitting, is illustrated, suitable for outdoor use; the light can be varied between 60 and 820 c.p. A new type, "D," similar in appearance to the "B" pattern, is shown, which is suited for street lighting. Improvements have been made in the reflectors for the "B" type lamp, which shed all the light in one direction. They are of a very neat design, and are intended for indoor use. The "Express" Nernst lamp fittings and electroliers, are also illustrated; they give light immediately by means of glow lamps which are fitted above the Nernsts and are switched off automatically as soon as the filament is alight.

Brush Contracts.—The Brush Electrical Engineering Co. has booked the following contracts:—Three 50-kw. three-phase transformers, ordered by Mr. C. H. Merz, for Sir W. G. Armstrong, Whitworth & Co.; complete steam and electrical plant for power house, for the Leamington and Warwick Tramways; three double-deck cars with radial trucks and Brush motor equipments for the Airdrie and Coatbridge Tramways.

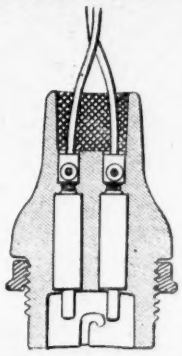
"Witton" D.C. Motors.—This type of motor forms a leading speciality of the General Electric Co., Ltd, 71, Queen Victoria Street, E.C., who manufacture them in large quantities at their Witton Works, Birmingham. The machines are designed and built on modern lines, the parts being all standard and



The "Witton" D.C. Motor.

strictly interchangeable. The motors can be fixed with the base either horizontal, vertical or overhead, the bearings being designed to allow for this; they are turned out in open-protected, semi-enclosed, enclosed-ventilated and totally enclosed types. The company has recently issued a comprehensive and well-illustrated d.c. motor catalogue, which should interest power consumers, as, in addition to prices, and dimensions and weights of motors, power data for various classes of machinery are appended.

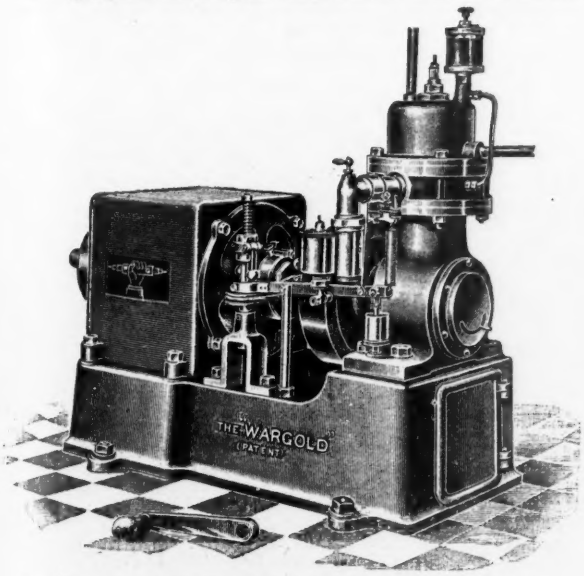
Porcelain Lampholder.—The Knowles patent incorrodible lampholder is constructed of a single piece of porcelain without any joint. The plungers, which are renewable, and their containing tubes, are cut out of solid brass rod, accurately turned and bored; the upper ends being tapped to receive the adaptors or sweating terminals to which the conducting wires are soldered. The terminals consist of square-headed brass screws, ¼ in. diameter; the heads being drilled to receive the conducting wires for soldering



Knowles Porcelain Lampholder.

in. The usual bayonet slots for receiving the pins on the lamp-cap are moulded on the inside of the lamp socket. The recess in the holder above the terminals forms a sealing chamber, which can be filled with compound, and after the lamp is inserted, the joint round the neck can also be made good by a lapping of asbestos yarn held in place by prepared tape. This holder is specially suited for use in chemical and similar works, battery rooms, and situations where a corrosive atmosphere exists, it being practically impervious to fumes or vapours. These lampholders can be obtained from Mr. C. E. Knowles, Holmdale, Glossop.

New Petrol Dynamo.—After experiments extending over a considerable time, Messrs. Ward & Goldstone, of Dutton Street, Manchester, have succeeded in putting on the market a new petrol engine and dynamo, for which many advantages are claimed. The engine is of a special patent type, which is quite different to any other; perfect steadiness of running is obtained, owing to there being an impulse to every revolution, not, as in most engines, to every two revolutions. The engine is very simple in construction, and mechanical troubles are reduced to a minimum by the absence of sliding valves. The engine and dynamo take up a remarkably small space, and this is a point which is much in favour of the set



Petrol Engine and Dynamo.

for Colonial use, as it can be shipped to the Colonies at very low rates. Petrol can be obtained from most wholesale ironmongers at 9d. per gal., and at this price the cost per unit works out for petrol at about 2d, that is to say, the engine will work for one hour and light 40 8-c.p. lamps with a consumption of 2d. for petrol. The output of the engine is 2½ h.p. It is started similarly to the engine of a motor-car, a turn of the shaft by a handle which is provided being usually sufficient to start the engine. At present the set is made up in one size only, but larger sizes are in construction, and on these the economy of working will be still more pronounced. The complete set takes up a space of about 2 ft. 3 in. × 1 ft. 3 in., which is remarkably small for a set of this description. It works without any attention after being oiled. A set can be seen at the makers' works running on load.

Trade Announcements.—We understand that the Sunbeam Lamp Co., Ltd., owing to increased trade have been compelled to remove their business in London to larger premises at 102, Charing Cross Road, W.C., where they will shortly be opening out an extensive showroom of their various manufactures, including "Reyrolle" specialities. This change will enable much larger stocks to be carried. The actual date of removal will be announced later.

Regarding the recent announcements by leading cable manufacturers that they are increasing their prices and adopting a second quality cable at a lower price, Messrs. J. Frankenburg & Sons, Ltd., of Salford, inform us that it is not their intention to adopt this policy. Their wires and cables are all first quality, being made in accordance with the standard adopted by the Cable Makers' Association for their best cables. As they are not issuing a new price list at present, the old one will remain in force until further notice.

The Alliance Electrical Co., Ltd., are removing to larger offices at 23, Grafton Street, London, W. We have received an illustrated pamphlet from the company on "Electric Power; its Developments, its Advantages and its Uses," showing a number of applications to which electricity is being put.

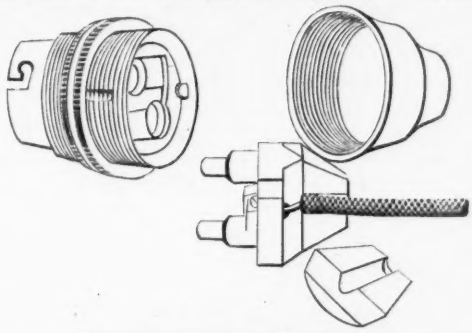
Dissolution and Liquidations.—The Fireproof Electric Switchboard Co., Ltd., is winding up voluntarily with Mr. Thomas Lomas, 86, Egerton Street, New Brighton, as liquidator.

A meeting of Bryan, Donkin & Co., Ltd., is to be held at Lincoln Works, Chesterfield, on April 3rd, to hear an account of the winding up. A similar meeting of Clench & Co., Ltd., is to be held at the same time and place.

Messrs. G. H. Woods and R. B. Slacke (G. H. Woods, Slacke and Co., electrical engineers, Blackburn) have dissolved partnership. Mr. Woods will attend to debts.

A meeting of the River Plate Electric Light and Traction Co. is to be held at 78, Coleman Street, E.C., on April 13th, to hear an account of the winding up from Mr. W. T. Western, liquidator.

The "Thikflex" Cord Grip Lampholder.—From Messrs. Baxendale & Co., of Miller Street Works, Manchester, who are the patentees and makers, we have received a specimen of this ingeniously-constructed lampholder. Its most prominent and welcome feature is simplicity; but it is also substantially made, and, we should judge, well adapted for use in works and under conditions where it would be subjected to rough usage. It consists of



Thikflex Cord Grip Lampholder.

a two-part case, which, when screwed together, rigidly locks the interior fittings. The latter consist of a china interior in two parts, which lock together (enclosing the terminals, all but the lamp plungers) and the cord grips. The interior is of best English china, and the terminals are detachable to facilitate wiring. The cord grips do not belie their name, as when the holder is fitted up it is impossible to twist either the cord or the grips. As these holders combine with the above advantages, the further one of moderate price, they will doubtless find an extended use.

LIGHTING AND POWER NOTES.

Bath.—The Committee's recommendation regarding electric light extensions and improvements has been adopted by the T.C. By the resolution carried, application is to be made to the L.G.B. for leave to borrow £7,000 for additional plant, and £3,000 for mains extensions; also £900 for improvements in the public arc lighting, as suggested by the city electrical engineer, Mr. Teague.

Blaydon-on-Tyne.—On 2nd inst. the U.D.C. resolved to apply to the B. of T. for authority to transfer its E.L. order to the Durham Electrical Power Distribution Co., Ltd.

Canada.—The Maine and New Brunswick Electric Power Co., whose head office is at Andover, N.B., will shortly commence development work on its property at Aroostook Falls, N.B. There is a head of 75 ft., and the company's engineer estimates that 4,000 h.p. is available. Five pairs of wheels of 800 h.p. each pair will probably be installed. It is proposed to furnish light and power to the principal towns of Aroostook County, Maine, and to Perth and Andover in New Brunswick.

It has been suggested to the Toronto City Council that a committee be appointed to consider the advisability of installing a municipal plant for public lighting. The public lighting contract held by the Toronto Electric Lighting Co. expires at the end of the present year.

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The Goderich (Ont.) T.C. is considering extensions to the electric light plant, at an expenditure estimated by the town engineer at $10,000.

The St. Mary's (Ont.) T.C. has commissioned Mr. Willis Chipman, C.E., of Toronto, to furnish an estimate of the cost of making improvements and additions to the E.L. plant.

The Calgary (Alberta) City Council has called for tenders for the erection of a municipal electric lighting plant. One 225-kw. two-phase 2,300-volt generator, direct connected to a 300-h.p. condensing Corliss engine running at 150 r.p.m., is to be installed. The City will have to compete with a privately-owned plant, but as the citizens are not satisfied with the treatment they receive from the private company, it is expected that the municipal plant will obtain sufficient support to enable it to compete on a business basis with the present company. Mr. F. W. Thorold is the city engineer, and tenders will be received up to March 15th, the work to be completed by October 1st. The possibility of a street railway franchise being sought by a corporation is an extra inducement to the City to take up municipal trading, as the tramway franchise will be given on terms that will compel the use of energy from the municipality. For authority to expend $60,000 on the above plant, the scheme was submitted to popular vote and carried by a very large majority.

Colchester.—In order to encourage consumers of electricity on the slot system to keep their lamps in good order, it has been decided by the E.L. and Power Committee to give new lamps in exchange for old after every 40 units of electricity have been registered on the meter.

The T.C. has received from the L.G.B. sanction to raise a loan of £12,920 for E.L. purposes. The sum applied for was £16,500.

Continental Notes.—Italy.—Application has been made to the Bergamo prefectural authorities for power to erect a generating station and supply electrical energy to Gazzaniga. The water power of the River Vertova is to be utilised for the scheme.

Bavaria.—The municipal authorities of Landshut have resolved to erect an electricity works for the town.

Austria.—In connection with the extension of the Grand Duke Frederick's ironworks at Trzynietz, Austria, the A.E.G.-Union Gesellschaft, of Vienna, has secured a contract for a large electric power plant operated by steam turbines and intended for the driving of the rolling mills; it will comprise three 750-h.p. triple mills, and a 3,000-h.p. reversing mill. The latter will, it is stated, be the first to be electrically operated.

France.—The district authorities at Besançon have granted the Gas Co. a concession, whereby it can generate and supply electrical energy for lighting and power in the district.

Crewe.—The T.C. has been recommended to lower the price of energy for public lighting by ¼d. per unit from March 31st.

Darlington.—The T.C. on March 2nd decided to apply to the L.G.B. for a loan of £2,100 for extending the generating plant.

Dartmouth.—The Urban Electric Supply Co. (Messrs. Edmundson's) has held an electrical exhibition at this South Devon port. It proved of much interest to the locality; the number of visitors amounted to 2,801, and the receipts totalled £57 15s. 6d., which sum has been handed over to the hospital.

Dewsbury.—Application is to be made to the L.G.B. by the Dewsbury Corporation for sanction to borrow £10,000 for additional plant and cable required for the electricity undertaking. It is not proposed to spend the whole of this amount at once, but £10,000 is being asked for to avoid repeated applications.

Dover.—On the advice of the B. of T. the T.C. has excluded Hougham from the order extending the area of supply outside the borough.

The T.C. has appointed Mr. V. P. Martin (one of the staff at the works) to canvass for E.L. consumers, at a commission of 6d. per lamp for all over 300 obtained per month.

Dublin.—The Blackrock U.D.C. has asked the consent of the Corporation to its taking a supply of electrical energy from the Dublin United Tramways Co. for lighting purposes until the Corporation is in a position to contract for such a supply. The U.D.C. points out that it would mean considerable expense to the Corporation to undertake a supply at present, that the tramway company can supply from its existing mains, and that the prov. order will be cancelled if not proceeded with shortly; but in spite of these good reasons, the Corporation will not assent to the proposal.

Exeter.—The T.C. met in committee recently to consider report by the special committee appointed to investigate the management of the E.L. undertaking. The committee states that after careful inquiry, it is fully satisfied as to the competency of Mr. Munro as an electrical engineer, and is of opinion that the electrical engineer should have charge of all the works in connection with the undertaking, including mains, and of the electrical equipment in connection with the tramways. Having regard to the extent of the works and the growth of the undertaking, the committee is of opinion that this is sufficient to fully occupy the time of Mr. Munro, and that some other arrangement should be made, by a readjustment of the present staff, with regard to the supervision and control of what may be called the mercantile side of the undertaking by an officer who should be in direct communication with the committee. The committee recommends that the matter should be again referred to it in order that it may report upon the general question of the management of the undertaking.

Elland.—The result of the first year's working of the U.D.C. combined electricity works and destructor shows a gross profit of £213, and after allowing for sinking fund charges, &c., there is a debit balance of £670. Only £36 has been expended on coal during that period, and the cost of destroying refuse, &c., works out at 9½d. per ton.

Farnworth.—The U.D.C. has adopted a system of free wiring and has decided to retail lamps at the E.L. works.

Faversham.—The consulting engineers (Messrs. Talbot and Stevenson) have recommended the T.C. to provide additional engine power at the E.L. works at an estimated cost of £4,800, in order to avoid a possible failure of supply next winter.

Felixstowe.—The U.D.C. has rescinded the resolution that the reduction in the price of energy from 8d. per unit to 6½d. shall only apply to cases where the account is paid within one month of delivery.

Finchley.—On the recommendation of its Electricity Committee and its electrical engineer, Mr. Calvert, the U.D.C. has resolved to apply to the L.G.B. for sanction to borrow £23,500 for extensions to the plant, made up as follows:—Machinery, £5,450; water supply, £2,180; buildings, £6,750; mains, £5,370; services, £2,200; contingencies, &c., £1,500.

Friern Barnet.—The U.D.C. decided recently to apply for a further extension of its prov. order for 12 months.

An application has been before the D.C. for some time from a factory owner on the south side of the district for permission to have a cable laid to his works from the Hornsey Borough mains, but consent had been refused. Now, however, consent has been given by the Council, subject to the terms of the contract meeting with its approval.

Guildford.—There appears to be trouble with smoke at the electricity works. The Electricity Supply Co. has at times been served with various notices on this score. The engineer states there has been a breakdown in the mechanical stokers, and that there is a boiler under repair, the result being that some furnaces have been forced. The company has been fined £1, but a request by the Town Clerk that a continuant penalty up to 10s. per day be granted was not allowed.

Huntingdon.—Mr. F. J. Warden-Stevens, of Westminster, has been retained by the Corporation to advise regarding an electric lighting scheme.

Killarney.—The U.D.C. has been informed that the Killarney Electric Lighting Co.'s undertaking, recently put up for sale by the Chancery Court, has been purchased by Mr. V. A. Ryan, electrical engineer, Dublin, who, it is stated, intends to run the concern in future.

Lancashire Electric Power Co.—The laying of cables by this company for electric light supply to Swinton and Pendlebury is proceeding, the local authority having entered into an agreement for a supply in bulk from the Radcliffe generating station.

London.—Bulk Supply.—The *Westminster Gazette* recently published an article describing an interview with one of the promoters of the large power scheme for the London area. A representative of the *Daily Chronicle* has also obtained some information on the company's side of the question, and it is to be hoped that those who read these articles will understand how such a scheme will affect municipal and other electric lighting undertakings.

Hackney.—The E.L. Committee of the B.C. has recommended that the present arrangements for supplying water to the works be supplemented. The consulting engineer recommends the sinking of an artesian well, at a cost, including electrically driven pumps and an overhead storage tank, of £2,000, and the Committee has decided in favour of sinking the well. Mains extensions, estimated to cost £420, are to be carried out.

Metropolitan Asylums.—The Board has resolved to apply to the L.G.B. to be allowed to follow "the precedent advantageously adopted in the electric lighting of its other buildings," and to invite tenders for the installation of proposed systems of electric lighting, telephones and fire alarms at the Southern Hospital from nine selected firms. The engineer-in-chief approximately estimates the cost of the works at £9,000. This includes £3,000 for underground mains.

Maidstone.—On March 2nd a L.G.B. inquiry was held relative to the application of the T.C. for a loan of £6,000 for E.L. purposes. The amount is made up as follows:—Coal store, £330; indicators, &c., £3,708; public lamps, £620; balancer and switchboard, £550; feeder cable, £550; contingencies, £97. Certain ratepayers offered opposition, on the ground of heavy expenses incurred for sewage works and tramways.

Melton Mowbray.—The electrical exhibition (Messrs. Edmundson's) held from March 1st to 4th, was an unqualified success. Although the population of the town is only about 7,500, 4,784 persons visited the exhibition and evinced considerable interest in the numerous adaptations of electricity to light, heat, power and therapeutics. It was not expected that the receipts would cover the cost of preparing the exhibition; these, however, totalled £53 19s. 10d., which allowed of a cheque of £22 5s. 9d. being handed to the local hospital.

Mexico.—The electricity works of the Compagnie Mexicania d'Electricita in the city of Mexico was destroyed by fire on the 4th ult. The company undertook the public lighting, and the streets were consequently in darkness on the night of the outbreak. La Compagnie d'Electricité de San Ildefonso, however, came to the rescue, and by connecting up its plant to the street mains, was able to re-light the public lamps the following night.

Monte Video.—A report on the result of the past year's working of the municipal electric lighting department has been presented, and states that the revenue amounts to $129,184, as against $107,256 the previous year, and the expenditure $95,496, as against $157,777, leaving a credit balance of $33,687, against a loss of $50,520 the year before. Public lighting increased by 180 incandescent and 123 arc lamps, costing for service $27,330. Revenue is only received from private lighting, but the department also has to carry out the whole of the public lighting of the city.—*Review of the River Plate.*

Peterborough.—The T.C. has applied for a loan of £3,400 for E.L. purposes.

Ramsgate.—The T.C. has agreed to sell a site at Whitehall to Edmundson's Electricity Corporation, Ltd., for £600, on which to erect a generating station.

South Shields.—The T.C. on March 1st, reduced the price of energy on the flat rate from 5d. to 4d. per unit, and on the maximum demand system from 2d. after the first hour's consumption to 1½d. per unit.

Stockport.—A loan of £6,125 for the purchase of motors to be let out on hire, has been applied for by the T.C.

Sutton Coldfield.—A loan of £8,000 for extensions of the E.L. mains and the generating plant, has been applied for by the T.C.

Torquay.—The result of the post card poll on the question of the proposed municipal expenditure on the E.L. undertaking, is 2,570 against and 417 for it.

U.S.A.—Buffalo, N.Y.—The Iroquois Electric Light Co. is applying for permission to enter into competition with the Buffalo General Electric Co., offering to pay the city 2½ per cent. of its gross proceeds for a five years' lease. There is much opposition to the application. The existing charge for arc lamps is £15 a year, and it is suggested to entain the new proposal if the Iroquois Co. will supply lamps at £14.

New York City.—The proposal for the establishment of a city lighting plant has resulted in the presentation of a very hastily-prepared plan calling for the expenditure of £825,000 for supplying energy for street lamps and public buildings in the boroughs of Manhattan and the Bronx. Estimates for Brooklyn are being prepared. The proposed plant is to be of 10,000 KW. capacity, supplying 6,000 arc lamps of 450 watts, and 250,000 incandescent lamps of 16 C.P. The items include £250,000 for the generating station, and £450,000 for high tension cables, transformers, switchboards, arc light circuits and centres of distribution. The controversy concerning the proposal is still raging.

Mr. Ernest H. Davis, president of the National Electric Light Association, reviewing the report of the Committee on the proposed municipal plant, states that a number of items of cost have been omitted which should be taken into consideration, and he argues that the estimate of 5·15 cents per KW.-hour should be increased to 12·88 cents, on which basis the cost per public arc lamp, instead of being $75 40 (£15 14s. 2d.) would be more than $140 (£20), the price at present charged by the New York Edison Co. On February 24th, the Board of Estimates passed an appropriation of £120,000 for the purchase of a site for a central station.

Wimborne.—The U.D.C. has decided not to oppose the application of the electrical supply company for a prov. order for electric lighting, the company having acceded to the Council's request to lay wires below the surface of the roads or overhead, as the Council may think fit.

TRAMWAY AND RAILWAY NOTES.

Belfast.—The Cavehill and Whitewell Tramways Co. has entered into an agreement with the B.E.T. Co., which provides for electrification and equipment by July 31st next.

The strike of labourers employed on the Corporation tramway reconstruction continues, and at the beginning of the week took a serious turn.

Brooklyn, N.Y.—The Rapid Transit Co. has, in appearance, if not in fact, frankly responded to the requirements of the State Railroad Commission to improve its service. The company has ordered 200 new surface cars, 100 new elevated cars, and 50 trucks for conveying city refuse, &c., about the borough. The total cost of these 350 cars is approximately £500,000.

Canada.—The Charter passed by the Dominion Government last Session, incorporating the Brantford and Hamilton Electric Railway Co., has now come into effect, and grants powers to construct an electric railway from Brantford to Hamilton. The company must expend $45,000 within two years, and complete the line within five years.

The Quebec Legislature will be asked to incorporate the Longueuil Tramway Co., to build an electric railway from Montreal to Longueuil.

Chicago.—The Supreme Court has ordered the Union Traction Co. to lower its tunnel under the Chicago River in order not to obstruct the navigation. The lowering is to be done at the cost of the company.

Darlington.—At a meeting of the T.C. on the 2nd inst. a report was submitted from the Tramways and Electric Lighting Committee, in which it was stated that the ½d. fares showed an approximate loss of £4 19s. 10d. per week, and Mr. Lunn, the electrical engineer, estimated that the loss would be £3 to £5 per week. He also stated that to meet the increasing demand for electricity there would have to be extensions of the works, and the cost, if what he proposed were carried out, would be from £2,000 to £3,000. It was reported that the estimated loss in working the trams up to March would be about £1,900, and the estimated loss for 1905-6 was £1,200, independent of the interest and liquidation of the old tramway system. Councillor Wooler, chairman of the Committee, moved the adoption of the report, and pointed out that under the terms of the Light Railways Order they could not deal with a deficiency until it arose. He said that there had been some criticism as to no allowance being made for depreciation of plant, but following the example of other companies, they were allowing nothing for depreciation for three years. Alderman Bartlett declared that the Corporation was being charged at a higher rate for energy than it had been proposed to charge the Imperial Tramway Co., and if this were altered it would make a difference of about £800 a year. The estimate for the ensuing year was based on the price of 1½d. per unit. The minutes were adopted.

Derby.—The T.C. has decided to lay down electric tramways in the Kedleston Road at a cost of £14,000, to join the Pear Tree and Dale Road routes at a cost of £5,245, and to purchase four cars at a cost of £2,320. Some 380 residents in the Kedleston Road district presented a memorial in favour of a tramway in that district. It was announced that during the 30 weeks in which electric cars had been running, 3,419,400 passengers had been carried, and the receipts averaged 10½d. per mile. The Tramways Committee had decided not to adopt motor-'buses, owing to their excessive first cost and high running charges, estimated at 11½d. per mile, compared with 5·5d. to 6d. per mile for electric cars.

Douglas.—The Tramways Committee is considering the advisability of obtaining motor-'buses for traffic purposes in the town, and has declined for the present season to adopt penny stages on trams.

Dover.—The T.C. has received sanction for the following loans in connection with the extension of the tramways to River:—Construction, £15,707; electrical equipment, £2,269; cars, &c., £3,024.

Leicester.—At last week's T.C. meeting, Councillor Flint, in moving the adoption of the report of the Tramways Committee, said that the total receipts during the year, including rents and bank interest, were £79,900, and the working expenses £47,993, leaving a gross profit of £31,907. They had paid in interest and sinking fund £18,849, leaving a net balance on the year of £13,088. Comparing the two years, the gross receipts in 1904 were £79,125, against £47,599 in 1903, showing an increase on the year of £31,126. The working expenses in 1904 amounted to £47,993, and in 1903 to £38,850, an increase of £9,143. The passengers carried in 1904 numbered 18,394,183, against 10,813,430, an increase of 7,580,753. The car-miles run were 1,860,479, against 960,934. He was aware that their plant was very costly at present. It cost a great deal of money, but the increase in the interest and sinking fund to cover that would be much more than compensated for. Of that he had no shadow of doubt. He thought that that was all in favour of the system they had adopted in Leicester. It was urged at one time by members of the Council and others that they ought not to have gone in for the overhead system. They were advised to adopt such a system as that at Wolverhampton, which was on the surface-contact system. But the Wolverhampton tramway system was now on the rates. The people were, further than that, very much dissatisfied with their system, and at the last meeting of the Wolverhampton Council a resolution was submitted from the Tramways Committee that motor-'buses be substituted for the trams. Yet when the Committee visited Wolverhampton, the Wolverhampton Council had such faith in their cars that they were told that Leicester would certainly adopt the surface-contact system. Councillor Flint proceeded to read what Mr. Clifton Robinson said about motor-'buses. As to the balance of £13,000, the Committee had decided that that amount should be appropriated to a reserve fund and that that fund should be for the purposes of maintenance, renewals and repairs. If they put it to a depreciation fund they would lose control over it. After a lengthy discussion the report was adopted.

Live Rail Accidents.—In the House of Commons recently, Mr. Gerald Balfour, in reply to a question, said that on the Lancashire and Yorkshire and North-Eastern Railways nine fatal and 22 non-fatal accidents had occurred through contact with the electrically-charged rail, including eight fatal and eight non-fatal accidents to trespassers, and one fatal and 11 non-fatal fatal accidents to railway servants. No accidents from contact with the rail in question had been reported to the B. of T. on any of the other lines which had recently been equipped for the use of electrical power in place of steam, and no such fatal accident had, it

was believed, occurred on any of the tube railways. The number of non-fatal accidents of this description on tube railways, some of which had been opened now for a considerable period, could not be given, as no separate record of such accidents had been kept, but the number, if any, must be very small. Recommendations as to the steps to be taken to prevent the occurrence of accidents of this character had been made from time to time to the railway companies, and had been adopted by them. The matter was one that received unremitting consideration from the inspecting officers of the department in the execution of their duties.

London.—At a meeting of the L.C.C. on Tuesday, the Highways Committee presented a report relating to accommodation for the repair and overhauling of the electric tramcars. It was considered that special repair shops should be provided in some central position for this purpose, and for the making of spare parts which were now obtained from the car-builders. It was probable that by direct production in the Council's workshops, equipped and operated in a thoroughly economical and systematic manner, spare parts could be supplied at a cheaper rate and with greater dispatch than hitherto. The Committee proposed to report at a later date upon a suggestion to erect new buildings specially for the purpose, as some time would be occupied in framing a comprehensive scheme that would meet the demands of the undertaking as it was likely to be developed in the future. In the meantime it was desirable to have more satisfactory provision than at present existed for the repair of cars, and a temporary workshop as an instalment of the larger scheme could be arranged at the car-shed building for the Council at New Cross Gate. It would be necessary to provide plant, tools, and machinery, and the Council sanctioned an expenditure of £5,000 for their purchase from firms to be selected by the Committee.

The *Times* says it is anticipated that the Royal Commission on London Locomotion will finish its inquiry about the end of June.

The Metropolitan Water Board having lodged a petition against the Metropolitan Electric Tramways Bill, in order that a protective clause should be inserted with regard to alterations in the positions of pipes, the promoters' agents offered to deposit with the Board £500 to defray the cost of such alterations. On the advice of its chief engineer, the Board on Friday agreed to withdraw its opposition on receipt of the £500.

Long Island Railroad.—A beginning has been made with the work of laying the power rail on several sections of the Long Island Railroad. Electric traffic is promised to commence on June 1st.

Mount Blanc Electric Railway.—A company has just been formed at Paris with a view to constructing and operating an electric railway, which will carry tourists to the summit of Mount Blanc. The capital necessary, 10,000,000 francs, has been subscribed during last month. Electric energy will be generated from the numerous streams which flow down the mountain. This undertaking will be a great boon to travellers, as the present cost of guides is £12, whereas the railway fare is to be £2.

New York City.—The extension of the subway along Lower Broadway is promised to be in working order by June 1st. Trains will run in the tunnel under the Hudson to Brooklyn a few weeks later. Plans are being considered for the enlargement of the platforms of the subway stations, so that eight or ten-coach trains can be accommodated instead of five or six as at present. The electrical equipment of the New York, Westchester and Boston Railway Co. will be identical with that of the subway, and there will be through traffic. The Westchester line is to be commenced as soon as weather permits, and will be finished in about two years.

N.E. Railway.—The N.E. Railway Co. are now trying a new ballast on that part of the track which is electrified. This is stated to be a much better non-conductor than the ordinary ballast, and it also drains away moisture much more rapidly, thus lessening the severity of the shock in case of accident.

Pontypridd.—The completed portion of the system of electric tramways in course of construction by the D.C. was opened on Monday morning last. The route extends from Treforest, through Pontypridd to Coedpenmaen, Norton Bridge and Cilfynydd. In January, 1903, the B. of T. held its inquiry at Pontypridd into the application of the U.D.C. for powers, and granted the application in due course. In the same year, tenders were obtained and accepted for the various works. The generating station, combined with the refuse destructor and car depôt, is situated on some ground adjoining the Council gas works at Treforest. On account of the narrowness of the streets, the B. of T. compelled the Council to put in double lines the whole way, with some special crossings to enable the cars to travel on either line, with a view to reducing obstruction to traffic to a minimum. The gauge is 3 ft. 6 in. The contractors for the whole of the track work were Messrs. R. W. Blackwell and Co., Ltd., of London, and for the overhead equipment the British Insulated and Helsby Cables Co., Ltd., of Prescot. The underground cables were supplied by Messrs. W. T. Henley's Telegraph Works Co., who experienced considerable difficulty, owing to the narrowness of the streets, in which gas and water pipes and mains belonging to the South Wales Electrical Power Distribution Co., Ltd., lie in close proximity. The buildings were erected by Messrs. Hughes & Stirling, of Liverpool, and the following plant is installed therein:—Three engines of the vertical cross-compound Corliss type, provided with patent reheaters (one of 500 H.P., and two of 260 H.P., with speeds of 125 and 150 r.p.m. respectively), supplied by Messrs. Coombe, Barbour & Co., Belfast. The engines are coupled to dynamos by Messrs. Greenwood & Batley, Leeds, arranged for supplying either the lighting or traction supply. The switchboard is of Messrs. Ferranti's well-known type. Balancers are provided for the lighting system, and were supplied by the British Westinghouse Co., Ltd. In the boiler house, two boilers are installed; these are to be supplemented by two boilers in the destructor house, not yet fixed. They were supplied by Messrs. Babcock & Wilcox, for a working pressure of 200 lb. per sq. in., and are fitted with that firm's usual type of superheater. The same firm also supplied and fixed the whole of the pipework and feed-pumps, together with a Boby water softener. A Green economiser of usual type is also installed. The arc lamps, of which there are 40, are of Messrs. Johnson & Phillips's enclosed type, and are fixed on the top of the tramway poles. The cars were supplied by the British Thomson-Houston Co., Ltd., of Rugby, who sub-let the contract for bodies to the Brush Co., of Loughborough. Six cars are of the double-deck type, and six single-deck, all of them being fitted with Brill bogie trucks, driven by two G.E. motors. Each car is also fitted with the Westinghouse magnetic track brake. The total length of track at present equipped is a little over 3½ miles, and an extension of 1½ miles to Hafod is in progress. The work has been supervised by the consulting engineer to the Council, Mr. R. P. Wilson, of Westminster.

Sedgley.—An accident occurred on the tramway last week. A car was proceeding down-hill from Sedgley to Wolverhampton, when the driver discovered that both his ordinary and electrical brakes would not act. The car began to attain considerable speed, when another car appeared, coming in the opposite direction. The driver of the second car fortunately grasped the situation and reversed the motion of his car. The runaway, however, soon overtook the retreating tram, and a collision ensued. The first car was brought to a standstill by the impact, and the driver of the second car also succeeded in stopping. Both cars were damaged, and the passengers considerably shaken.

Tramways and Light Railways.—The return relating to street and road tramways and light railways which has just been issued, gives the following figures down to December 31st, 1903, in the case of companies, and March 31st, 1904, in respect of local authorities:—

Method of traction.	England and Wales. M. Ch.	Scotland. M. Ch.	Ireland. M. Ch.	Total. M. Ch.
Electric	1,233 80	140 7	89 44	1,462 1
Steam	75 53	—	33 5	108 58
Cable	8 67	21 3	—	29 70
Gas-motors	4 2	—	—	4 2
Horse	177 5	18 2	40 15	235 22
Total	1,497 77	179 12	162 64	1,889 73

	Belonging to local authorities.	Belonging to other than local authorities.
Capital expenditure on lines and works open for traffic	£19,544,414	£14,617,349
Total expenditure on capital account ..	£28,060,524*	£18,330,920†
Length opened for traffic—	M. Ch.	M. Ch.
Double	768 11	291 72
Single	379 48	400 22
Total	1,147 59	692 14
Number of undertakings	162	150

* These figures include, in several cases, the amounts expended by the lessees of local authorities on buildings and equipment for working the lines.

† These figures include cost of buildings and equipment in respect of certain local authorities' lines worked in conjunction with other lines.

The following particulars of the ratios and percentages which the compilers have derived from the present return, show a comparison of the electric, steam and horse periods:—

	1903-4. Electric period.	1893. Steam period.	1879. Horse period.
Capital expenditure per mile of single track open:—			
Lines and works	£11,780	£7,770	£7,840
All items	£16,018	£10,469	£9,877
Percentage of net receipts to capital outlay ..	6·27	6·38	3·97
Percentage of working expenditure to gross receipts	66·15	76·93	83·81
Passengers carried per mile of route open ..	977,951	806,703	469,641
Passengers carried per car-mile	9·23	9·48	7·77
Average fare per passenger	1·11d.	1·43d.	1·84d.
Amount paid in relief of rates out of profits of undertakings worked by local authorities	£207,087	(Not given)	(Not applicable)

The document, as compared with those issued in previous years, has now been enlarged and the return adapted to the circumstances of electric traction. The complete report should be of value to all concerned in the progress of tramway electric traction.

South Shields.—At a meeting of the T.C. on the 1st inst., the question of the substitution of motor-'buses for the proposed electric tramways in the borough was further debated. Ald. Readhead presented a memorial from the local Property Owners' and Ratepayers' Association, asking the Council to consider the question of running motor-'buses in place of the proposed trams, and urging that the former were more economical, and had other advantages over the latter. The alderman suggested a trial of the motor-'bus at a cost of £3,000 for a year, to test their efficiency, remarking that if they embarked upon the tramway scheme it would involve an outlay of £200,000. He moved that the memorial be sent to the Tramways Committee. Ald. Bowman seconded, and the motion was agreed to. Councillor Grant, in presenting the Tramways Committee's report, assured the meeting that the outside cost of the tram system would be £120,000, and no case had been made out for a deviation from the suggested plan of tramways. Councillor R. D. Barlow moved that the Committee be instructed to investigate and report upon the advisability of adopting motor-'buses instead of electric tramways, and that until such report were presented, no further steps in regard to the tramways be taken.

This motion was seconded, and then the question was raised as to whether the Council had power to run 'buses. The town clerk replied that as an auxiliary to the tramway system they could run omnibuses, either during construction or repair of their system, or along routes in which it was contemplated to lay the lines. They had borrowing powers, but the amount and necessity for them was for the Local Government Board to determine. After a somewhat prolonged debate an inquiry was agreed to.

Stockport.—The Corporation Tramways Committee, after ascertaining the cost of running motor-'buses at Eastbourne, has decided to proceed at once with the electrification of the Edgeley route.

The Underground.—The impending electrification of the District Railway has led to a difference between the management and the men on the subject of wages. A proposed table of rates has been issued to the employés, who, under the new conditions, fall into three classes—motor-men, conductors, and gatemen, corresponding in position to drivers, guards, and under-guards. Subjoined is a comparison of the two rates:—

	Drivers.	Guards.	Under-guards.
Present wages	42s. to 56s.	32s. to 34s.	23s. to 29s.
Proposed wages	Motormen.	Conductors.	Gatemen.
	35s. to 42s. 6d.	25s. to 30s.	21s. to 22s. 6d.
Reduction ...	13s. 6d.	4s.	6s. 6d.

The week, says the *Telegraph*, is to be reduced to six days, and the proposed day is one of 10 hours, with intervals. These terms were considered by the men on Monday, and the result of discussion was the formulation of a counter-proposal, which was embodied in a communication to the directors.

TELEGRAPH AND TELEPHONE NOTES.

Anglo-Chinese Telegraph Convention.—Mr. Berrington, director of the traffic branch of Indian telegraphs, has proceeded to Shanghai to assist in negotiations for the renewal of the Anglo-Chinese Telegraph Convention of 1894. The better maintenance of the line on the Chinese side of the Burmo-Yunnan frontier and a reduction of rates are understood to be the chief points to be urged and discussed with the Chinese representatives.

Municipal Telephones and the Post Office.—The Postmaster-General, Lord Stanley, M.P., received at the House of Commons on the 6th inst. a deputation headed by the Lord Provost of Glasgow, of municipalities owning and working telephones, who desired to show how the proposed purchase agreement between the Postmaster-General and the National Telephone Co. affected them and also those municipalities in which the National Telephone Co. have at present a monopoly. The points put forward by the deputation in their memorandum were—(1) That the partial purchase of the London system of the National Telephone Co., and the postponement of the purchase of its provincial systems was to be deprecated, because it would enable the company to devote greater energy and capital towards crushing out the municipal telephone system in the provinces; (2) that their experience had proved that it was not essential for the telephone service to be conducted as a national monopoly, for from 97 to 98 per cent. of the total calls were local; (3) that the Post Office ought to administer the acquired national system in friendly competition with the licensed municipalities, and give greater encouragement to other municipalities to enter the field; (4) that in the event of the postponement of a settlement, the Post Office ought to enter into vigorous competition with the company throughout the kingdom, assisted by the co-operation of municipalities, in order to avoid the danger of an inflated price being forced upon the Government; and (5) with regard to the possibility of extending the company's licence, it would meet with strenuous opposition from the municipalities, it would prolong the existing unsatisfactory condition of telephone affairs in this country, enable the telephone monopoly to reach such gigantic proportions as ultimately to render a reasonable settlement of the question impossible, and create a menace to the commercial interests of the kingdom. Lord Stanley, M.P., in reply, said he was strongly of opinion that the telephones should be nationalised, and he should be pleased to have another interview with them to have further developed this aspect of the question.

Post-Office Telegraphs.—A return has been issued showing that the gross amount received by the Post Office in respect of telegrams, private wire rentals, special wire rentals, and other sources was £4,208,427. From this sum the amount paid to cable companies, £529,520, and telegram moneys refunded, £4,749, must be deducted, leaving £3,674,138, to which is added the value of telegraph services performed for the other public departments without remuneration, which is put down at £61,957. The amount expended by the telegraph section of the Post Office in salaries, rent, and other respects during the same period is £4,693,897. The balance of expenditure over receipts is thus £957,782.

The *Times* says that the Estimates for Revenue Departments, Post Office, Post Office Packet Service, and Post Office Telegraphs, for the year ending March 31st, 1906, have been issued as a Parliamentary Paper. There are increases of £498,586 in Post Office, and £78,062 in Post Office Telegraphs, while under the heading Post Office Packet Service there is a decrease of £3,820.

Telegraphs and Telephones.—The Associated Chambers of Commerce has passed resolutions strongly urging the Government to establish, without further delay, additional cables between the United Kingdom and the Continent and also more direct wires between the chief commercial centres of this country (especially Liverpool) and Europe, including Continental centres for the distribution of telegrams. Also, that the Postmaster-General be at once empowered to lay all trunk wires underground, so as to obviate the delays which are at present so frequently caused by storms breaking down the overhead wires. And, that the present defective state of the telephone service between London and Paris being productive of serious inconvenience and loss to the commerce of the two cities, the Government be urged to make such arrangements with the French Administration as will render the service reasonably efficient and rapid for general commerce.

The *Daily News* states that telephonic communication between England and the Continent has been still further improved. It is now possible for Glasgow to ring up Marseilles with a modicum of delay. It has been said, they state, that although Leeds has been in telephonic communication with Paris for over 12 months, up to the present not a single call has yet been made. The authorities will neither confirm nor deny it.

Telegraphists' Salaries.—In the Commons on Tuesday, Lord Stanley said that he had no intention of raising the maximum pay of the general body of telegraphists in London, viz., £160 a year; but he hoped to make some improvement in the pay of the cable-room staff of the central telegraph office, which formed a separate establishment.

Telegraphic Interruptions and Repairs:—

	Cables, Interrupted,	Repaired,
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed Vladivostok-Nagasaki	Feb. 9, 1904	
Closed Port Arthur-Chifu	Mar. 9, 1904	
Paramaribo-Cayenne	Feb. 25, 1905	
Jamaica-Colon	Jan. 5, 1905	
Marmaritza-Rhodes	Jan. 30, 1905	March 1
Guernsey-England	Feb. 28, 1905	March 2
Gibraltar-Tangier	Feb. 20, 1905	March 2
Oran-Tangier	Feb. 24, 1905	
Souakim-Djedda	Mar. 25, 1905	
Landlines.		
Puerto-Barrios	July 28, 1902	
Kertch-Soutchoum	Sept. 27, 1904	
Rome-Pera	Jan. 27, 1905	
Bhamo route beyond Tali	Jan. 15, 1905	
Newfoundland—all places in the interior	Feb. 10, 1905	

The New Atlantic Cable.—The new cable of the Commercial Cable Co. to be laid between Nova Scotia and Ireland, by the northern route, will be about 2,300 miles in length and will cost about £460,000. Mr. G. G. Ward, vice-president of the Commercial Cable Co., when asked to explain why only English companies were asked to bid for this work, said:—"It is not because our company is failing in patriotism, but because there is no American cable company so well equipped that it could make and lay a cable of the standard of excellence we require in the time we want it. The English companies have complete facilities for the manufacture of the cable, and in addition they have steamships specially designed and manned for laying cables. The copper wire for the new cable will weigh about 600 lb. to the mile. The English companies insulate the wire with a covering of gutta-percha, held in place by a covering of steel wire. The manufacture of such a cable is a gigantic piece of work, but the English companies can turn it out at a rapid rate, and have every inch tested by trained men."

Telephone Employés.—A movement is making progress for the formation of a protective and insurance association among the employés of the National Telephone Co., in view of the proposed transfer of the system to the Government six years hence. 90 per cent. of the Liverpool staff has been enrolled, and it is expected that most of the 16,000 telephone workers will join the branches to be formed throughout the country.

The London Telephone System.—In reply to a question asked recently in the House of Commons, Lord Stanley stated that 11 Post Office telephone exchanges had been opened in the London area on December 31st last, and the number of subscribers' telephones working in connection with them was 22,181. The amount of the annual rentals and message fees received during 1904 was £156,485.

Wireless Telegraphy.—*Indian Engineering* says that wireless telegraphy has now been established between Diamond Island and Port Blair direct.

The Halifax (N.S.) *Morning Chronicle* states that during the recent storm the wireless telegraph mast at Cape Race, Newfoundland, was demolished.

The *Zeitschrift für Electrotechnik* reports that experiments in wireless telegraphy are at present taking place in Hungary on the initiative of the Post and Telegraph authorities of the country. On December 19th, 1904, communication was effected in a very satisfactory manner between a wireless telegraphy station situated at Csepel (Hungary) and the military station of Leopoldau, near Vienna. These two posts are 250 km. distant from one another. In spite of the chain of mountains separating the two points mentioned, the signals have crossed this distance with a relatively small amount of energy (5 H.P.), whilst in other countries at least double or triple the same amount of energy had to be employed. Experiments with the same system will be continued.

Telegraphs in the British Indies.—During the years 1902-3 and 1903-4 the system has increased by 6,219 kilometres of line and 34,595 kilometres of wire, the total of the former now being 96,044 and of the latter 341,168, besides 470 kilometres of cable. During the two years 23 new lines were constructed, of which the most important were from Nushki to Dalbandin, 185 km.; Dalbandin to Robat, 397 km.; Gilgit to Chitral, 331 km.; Teesta Bridge to Khambajong, *via* Gangtok, Lamteng and Tungu, 207 km., and from Rungpo to Gnatong, 162 km.. During the same period 16 lines, equalling 2,888 km., were re-constructed.

The Thibet Mission necessitated the construction of several new lines. The one from Gangtok to Khambajong enjoys the distinction of being constructed at a higher altitude than any other, the highest point reached being 5,333 metres. When the Mission quitted Khambajong and entered the Chumbi Valley, it had to abandon the Khambajong line at Lamteng, as the means of transport at its disposal were not sufficient to carry the material necessary in case of the destruction of the line. Later the construction of the line from Rungpo to Chumbi, *vid* Gnatong was hastened by means of land cable. From Chumbi the aerial line was extended to Pharijong. In connection with the Mission, 12 temporary offices and 13 country offices were opened during 1903-4. Of the former eight were closed and the remaining four were made military telegraph stations.

The following are the causes of interruptions during 1903-4:—

	Number of interruptions.	Duration in hours.
Faults on the lines and cables	420	5,145
Faults at offices	327	4,287
Cyclones and tempests	349	5,614
Floods	73	2,539
Fires	81	1,420
Fallen trees from causes other than storms	288	4,328
Birds and animals	678	7,269
	79	1,092
Unascertained causes	822	10,800

During 1902-3, on no less than 19 occasions parts of the copper telephone wires were stolen at Allahabad, amounting altogether to 3 kilometres. The copper wires are now being substituted by iron ones of small diameter, as the authorities were unable to trace the thieves, excepting in two cases.

Owing to the successful working of the Wheatstone automatic apparatus, it is to be introduced in all the offices of large towns. The Department also made experiments with wireless telegraphy between the islands of Sangor and Sandheads, and also between Elephant Point and Amherst, a distance of 133 kilometres, which were satisfactory.

Local traffic during 1903-4 amounted to 812,490 Government telegrams, 5,581,297 private and 11,303 "free." International telegrams numbered 913,300. The grand Durbar in 1902 was the cause of an abnormal increase of traffic, and 4,500 kilometres of special wire were laid to meet the telegraph requirements in connection therewith. A large office was opened in the camp at Delhi, which was in communication with all the different military departments as well as all the chief telegraph stations of the land. There were 63 Press correspondents present at the Durbar, who sent long dispatches to all parts of the world and all traffic was successfully handled.

Great trouble is experienced in the delivery of telegrams by reason of improper abbreviations in addresses, especially when they are in large towns, which has resulted in the non-delivery of many telegrams. Comparing January, February and March of 1903 and 1904, the number of telegrams in the latter period increased by 19 per cent.; whilst non-delivered telegrams increased by 30 per cent. During 1903-4 there was a decrease of 248 in Press messages, while private telegrams increased by 12,112, or 1·36 per cent. There was an increase of 591,587 words in international traffic, this being due principally to the reduction of the rate between Europe and China and the Russia-Japan war.

The opening of the direct cable between South Africa and Australia, and the laying of cables between Vancouver and Queensland and San Francisco and Manila are responsible for the decrease of 540,479 words in transit traffic.

During 1903-4 receipts amounted to 18,472,458 fr. (£738,898) and expenses to 13,171,652 fr. (£526,866), leaving a surplus of 5,300,806 fr. (£21,202) equal to 3·66 per cent. on the capital outlay, which at the end of 1903-4 amounted to 138,175,340 fr. (£5,527,014).—*Journal Télégraphique.*

CONTRACTS OPEN AND CLOSED.

OPEN.

Aston Manor.—March 24th. The Corporation invites tenders for the reconstruction of existing tramways in its district and the construction of other works in connection therewith. Consulting Engineer, Mr. Robert Green, 37, Waterloo Street, Birmingham.

Belgium.—March 22nd. Tenders are being invited by the Belgian State Railway Authorities, at La Bourse, Brussels, for the supply and erection of the plant and apparatus required for the electric lighting of the Sud station at Antwerp.

Bray.—March 20th. Electrical supplies for the U.D.C. See "Official Notices" March 3rd.

Bolton.—March 30th. Cooling tower and condensing apparatus. See "Official Notices" March 3rd.

Burton-on-Trent.—March 14th. 100-KW. C.C. tramway generator for coupling to existing steam plant. See "Official Notices" March 3rd.

Clyde.—April 10th. Electric power plant for Clydebank Dock. See "Official Notices" to-day.

Darlington.—March 20th. Tenders are required for a supply of motors on the hire-purchase system to consumers. See "Official Notices" March 3rd.

Derby.—March 21st. Permanent way, cars and electrical equipment for 2¾ miles of single line. See "Official Notices" to-day.

Dublin.—March 14th. The Improvements Committee invites tenders for two electric motors. Specifications at engineer's office, City Hall, Dublin, or at the offices of the consulting engineer, Mr. G. Chatterton, 6, The Sanctuary, Westminster.

Edinburgh.—March 13th. Carbons, meters, boxes, troughing and bitumen for the Electricity Supply Department. See "Official Notices" February 24th.

Gillingham.—March 27th. Coal for the electricity department. See "Official Notices" to-day.

Gloucester.—March 16th. Boilers, 600-KW. generator, condensing plant, piping, feed pump, &c., for electricity supply extensions. See "Official Notices" February 24th.

Gravesend.—March 14th. Engine room stores, oil, lamps, carbons, meters and indicators, cable troughing, &c. See "Official Notices" March 3rd.

G. W. Railway.—March 13th. Plant (three-phase and direct current) for the proposed sub-stations and distributing centres in connection with the Park Royal generating station. See "Official Notices" February 10th.

Hornsey.—March 27th. Cables, junction boxes, fuse boxes and meters for the T.C. See "Official Notices" to-day.

Hoylake and West Kirby.—March 21st. One 250-KW. steam alternator, piping, &c. See "Official Notices" March 3rd.

Italy.—April 3rd. Tenders are being invited until April 3rd, by the Municipal Authorities of Castrorillari, for the establishment of a central station for the public and private electric lighting of the town. Particulars may be obtained from, and tenders are to be sent to, El Consiglio Comunale di Castrorillari.

Johannesburg.—March 13th. Arc lamps and lanterns. See "Official Notices" March 3rd.

Keighley.—March 27th. Lancashire boiler and steam dynamo. See "Official Notices" March 3rd.

Leeds.—March 14th. Rotary converters, transformers, and switchboards for two sub-stations. See "Official Notices" February 24th.

Leeds.—March 15th. The Tramways Committee invites tenders for the supply of various material during the year ending March 25th, 1906. Mr. J. B. Hamilton, general manager.

Norwich.—March 20th. Wires, cables and lamps for the electricity department. See "Official Notices" to-day.

Porto (Portugal).—March 15th. The Town Council has opened a competition for the concession for the exclusive right of working the tramways for the collective transport of passengers, luggage, and goods in all the municipal public ways. The conditions of the competition are published at the Portuguese Consulate in London.

Plymouth.—March 18th. The Corporation is inviting tenders for lubricating oils, engine waste, &c. Mr. E. G. Okell, borough electrical engineer, Prince Rock, Plymouth.

Rotherham.—March 18th. Motor balancer; watering car and track sweeper for the tramways. See "Official Notices" to-day.

Salford.—March 18th. Rubber-insulated fire-resisting cables. See "Official Notices" to-day.

Shanghai.—March 31st. Construction and working of 24 miles of electric tramways on the trolley system, double or single. See "Official Notices" October 14th.

South Shields.—March 13th. Boiler, two vertical engines and 550-KW. traction generators, and traction switchboard for the Corporation. See "Official Notices" February 10th.

Spain.—March 14th. Municipal Council, Salamanca. Electric lighting of the town.

Spain.—April 8th. Office of Public Works, Madrid. Concession for an electric tramway line from Rue du Barquillo to Place d'Olavide, Madrid.

Swindon.—March 21st. Lamps, cables, oils, D.C. meters, boxes and feeder pillars. See "Official Notices" March 3rd.

CLOSED.

Belgium.—Six firms submitted tenders for the establishment of a municipal electric lighting station in the town of Saventhem, the lowest being that of the Compagnie des Constructions Electriques, of Charleroi.

Colchester.—The T.C. on March 1st accepted the tender of Messrs. Davey, Paxman & Co. for a Paxman Economic boiler, at £605, and pipework, at £155, for the E.L. Department.

Dover.—The T.C. has accepted the tender of Messrs. Dick, Kerr & Co., Ltd., for the supply of four tramcars, at £575 each.

Great Yarmouth.—Messrs. Jno. Russell & Sons, Ltd., of Wednesbury, have secured the order for poles for the Great Yarmouth Tramways, through the British Electric Equipment Co, Ltd. The length of route is 4 miles.

Ilford.—The U.D.C. has sealed a contract with Messrs. Pullen & Shore for the installation of a telephone fire alarm system throughout the district at £1,100.

Leek.—The U.D.C. has accepted the tender of Mr. John Richards for wiring and fitting the Town Hall for the E.L., at £87, and £35 extra for fittings. There were 34 tenders ranging from £82 16s. to £343 12s.

Newton Abbot.—The Board of Guardians has accepted the tender of Messrs. E. & E. Taylor, of London, for the supply of an electric lift at the workhouse, at £181.

Stockport.—The T.C. on March 1st accepted the tender of the British Thomson-Houston Co., Ltd., for the supply of tramcars, with Brush bodies.

Surbiton.—The U.D.C. has accepted the tender of Messrs. Kavanagh & Co., for the construction of a cooling pond at the E.L. Works, at £328 13s. 3d.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders are announced for next week:—

Monday, March 13.—"A" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Lecture on "Advantages of Polyphase Power Transmission," by Mr. F. Biliotti, A.M.I.E.E., at 8.30 p.m.
Tuesday, March 14.—"B" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Medical inspection for recruits and Special Service Section, 7 p.m. Lecture on "Nernst Lamp," by Lieut. E. G. Sheppard, 8 p.m.
Wednesday, March 15.—Submarine mining class, 6—9 p.m. Instruction in "Stoking Steam Engine," by Captain W. Bunn, 6.30 p.m. Examination "C" and "D" Companies for "A" badge, 7 p.m.
Thursday, March 16.—"C" Company. Recruits' drill, 6 p.m; technical instruction, 7 p.m. Lecture on "Carbons and their Manufacture," by Sergt. P. H. Nye, 8.30 p.m.
Friday, March 17.—"D" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m.
Saturday, March 18.—Week-end class.

J. J. F. O'Shaughnessy, Captain,
For O.C.E.E.R.E. (V.)

Electrical Contractors' Association. — Particulars have been issued in connection with the visit of the Electrical Contractors' Association (Incorporated) to Glasgow next week. On Monday the local branch will hold their annual dinner, at which it is expected Mr. W. R Rawlings, A.M.I.E.E, London president of the Association, will be present, along with representatives from London, Newcastle, Manchester, Liverpool, Leeds, Dublin, Edinburgh and other branches. On Tuesday the members will inspect the Allan line Atlantic turbine steamer R.M.S. *Virginian* in the forenoon. In the afternoon they will visit the City Chambers, where they will be received by the Lord Provost, Sir John Ure Primrose, Bart. Later they will proceed to Port Dundas electric lighting station, the Pinkston Tramway power station, and the Art Galleries. Following this a meeting of the Central Board will be held in the offices of the local section. The Glasgow Section of the Institution of Electrical Engineers has invited the delegates to be present at the discussion on a paper by Mr. W. W. Lackie, the new chief of the Glasgow Electric Lighting Department, on "Earthing," which takes place the same evening.

FORTHCOMING EVENTS.

To-day's Arrangements.—At 6.45 for 7 p.m. I.E.E. (Manchester). Annual Dinner at the Midland Hotel.
At 8 p.m. Physical Society. "On Direct Reading Resistance Thermometers, with an Appendix on Composite Thermocouples," by Mr. A. Campbell; and other papers.
At 9 p.m. Royal Institution. Prof. J. J. Thomson, on "The Structure of the Atom."

Saturday, March 11th.—At 3 p.m. Royal Institution. Prof. J. J. Thomson, on "Electrical Properties of Radioactive Substances." (Lecture I.)
At 3 p.m. Junior Institution of Engineers. Visit to new Ritz Hotel, Piccadilly, to inspect the "Cage Skeleton System of Constructional Engineering."
At 7.30 p.m. Birmingham and District Electric Club. "Electric Lifting Machinery," by Mr. E. C. R. Marks.
At 2.15 p.m. I.E.E. (London Students). Visit to Messrs. D. Napier and Sons' Works, Acton Vale, W.
Monday, March 13th.—At 8 p.m. Society of Arts. Cantor Lecture, "Telephony," by Mr. H. Laws Webb. Institution of Mechanical Engineers (Graduates' Association). "The Type of Locomotive best Suited to Heavy Express Trains."
Tuesday, March 14th.—At 7.30 p.m. I.E.E. (Manchester). "Low-tension Thermal Cut-outs," by Prof. Schwartz and Mr. W. H. N. James.
At 8 p.m.—I.E.E. (Glasgow). "Earthing." Adjourned discussion. By Mr. W. W. Lackie.
Wednesday, March 15th.—At 5.30 p.m. Chemical Society Meeting.
At 7.30. p.m. I.E.E. (Students). "Electrical Pyrometry," by Mr. P. L. Weir.
At 7.45 p.m. I.E.E. (Birmingham). "Commutation in a Four-pole Machine," by Mr. J. K. Catterson Smith; and, time permitting, "Notes on Heating and Sparking Limits in Variable Speed Motors," by Mr. A. H. Bate.
Thursday, March 16th.—At 7 for 7.30 p.m. I.E.E. (Students). Annual Dinner at the Holborn Restaurant.
At 7.15 p.m. I.E.E. (Leeds). "Power Gas," by Dr. F. H. Bowman.
Friday, March 17th.—At 7.30 p.m. I.E.E. (Manchester Students). "High-tension Switchgear."
Saturday, March 18th.—At 3 p.m. Royal Institution. "Electrical Properties of Radio-active Substances," by Prof. J. J. Thomson. (Lecture II.)
At 7.30 p.m. Glasgow Technical College Scientific Society. "Independent Condensing Plant," by Mr. Chas. Day.
Association of Engineers-in-Charge. Annual Dinner.

NEEPSEND GENERATING PLANT: WORKING RESULTS.

We have received from Mr. S. E. Fedden, engineer and manager of the Sheffield Electricity Department, some figures relating to the plant at the new Neepsend generating station of the Sheffield Corporation. The boilers and generators have now been in regular service for about five months. The turbo-generators—two in number—are of the revolving armature type, and are specified to give an output of 1,500 kw. at 2,000 to 2,200 volts, 50 cycles, two-phase on an inductive load having a power factor of ·85, and to have an overload capacity of 10 per cent. for one hour, with steam at a pressure of 190 lb. at the stop valve, superheated 100° F., and running at a speed of 1,500 r.p.m, the temperature of the circulating water being 60° to 80° F., as below:—

	Steam consumption, lb. per kw.-hour. Full load.	Half load.
With circulating water at 60° F. ...	18·4	21·2
do. 70° F. ...	19·5	22·5
do. 80° F. ...	20·2	23·4

The above figures do not include the air and circulating pumps, which are motor-driven from the station bus-bars. The exciters are direct coupled to the turbine shafts. Particulars of the test of these turbines at the makers' works were given in our issue of June 17th last, and a full description of the Neepsend station in our issues of July 15th and 22nd last. The same machines tested after erection at Neepsend in July last gave the following results:—

At stop valve.		Vacuum, inches.	Load in kw.	Steam used. Lb. per kw.-hour.
Pressure, lb. per sq. in.	Superheat, °F.			
179·8	92·7	27·08	1,596·9	18·9
193·7	100·8	27·40	1,611·4	18·3

Air and circulating pump motors used 2·14 per cent. of output. Exciter output was ·52 per cent. of total output.

After running for five months at 16 hours per day, six days a week, during which time the normal load had been about 1,000 kw. during daylight, and 1,400 to 1,600 during the dark hours before 11 p.m., an average was taken of 10 weeks—November 20th to January 22nd—with the results shown in the following table:—

190 lb.	100°	27 in.	979 kw.	22·41 lb.

The boilers are of the Stirling five-drum water-tube type, two in number, and are connected each to its own turbine, with provision for connecting to a common steam main if required. The fuel, a low grade slack, is fed by gravity through measuring chambers into the hoppers of Bennis sprinkler stokers, the grates being fitted with standard hollow bars and superheated steam jets by the same makers.

Each boiler has four furnaces, the air supply being induced and heated by the flue gases on the Ellis & Eaves system, with some additions by Mr. Fedden, which provide for a supply of heated air to the fire bar inlets as well as to the front of the furnace and bridge.

The specification for this steam-raising plant provided:—

1. That each boiler should be able to evaporate 30,000 lb. of water per hour (from and at 212° F.), assuming the calorific value of the fuel to be not less than 13,000 B.Th.U. per lb.

2. That the full load efficiency (30,000 lb.) taken over a period of eight hours should not fall below 75 per cent.

3. That the most economical load efficiency (25,000 lb.) should similarly be not less than 80 per cent.

4. That the heating surface should be 6,210 sq. ft., and the grate surface 72 sq. ft. Ratio of grate to heating surface 1 to 86·2.

These boilers were tested at Neepsend in July, 1904, over a period of eight hours, with the following results:—

Fuel. Shireoaks engine slack.

Calorific value, including 5·2 per cent. moisture	B.Th.U.	11,886·7
Total coal in eight hours	lb.	41,440
Average coal per hour per sq. ft. of grate ...	lb.	71·9
Total ash and clinker per cent.		7·72
Total water evaporated	lb.	354,850
Water evaporated per hour	lb.	44,356
Water evaporated per hour per sq. ft. of heating surface	lb.	7·14
Water evaporated from and at 212° F. per hour	lb.	54,096
Boiler pressure, average	lb.	196·8
Average superheat...	°F.	89
Water per pound of coal, actual...	lb.	8·563
Water per pound of coal from and at 212° F. ...	lb.	10·443
Factor of equivalent evaporation from and at 212° F., including superheat	...	1·2196
Average temperature of feed water	°F.	96·2
Average temperature of flue gases at fan ...	°F.	480
Average temperature of heated air entering fires	°F.	315
Average CO_2 in flue gases, per cent.	...	15·2
Average draught at fan suction, ...	in.	2
Efficiency, including superheat, per cent.		84·9

The costs at Neepsend station, averaged over 10 weeks, were as follows:—

Units generated	940,620
Working hours	960
Coal—Tons consumed	1,328
Cost per unit	·096d.
Water—lb. consumed (total)	21,079,000 (191,000 make-up water)
Cost per unit	·0012d.
Oil, waste, stores, per unit	·002d.
Salaries and wages per unit	·072d.
Maintenance, light, power for auxiliaries, &c. (charged at 5d. per unit)	·038d.
Total cost per unit...	·209d.

The plant is still in the makers' hands, but experience with similar machines in the Sheaf Street station does not lead Mr. Fedden to fear any notable increase in the upkeep charges after the period of maintenance has expired.

The foregoing results speak for themselves. Certainly, Mr. Fedden is to be congratulated on having laid out his new station on lines so successful, and the makers of the boilers and turbo-generators are no less to be congratulated upon the remarkable efficiency and economy attained by their respective installations.

NOTES.

Burton-upon-Trent Tramways.—At a recent meeting of the Gas and Electricity Committee, the report of the electrical engineer on the subject of extending the capacity of the tramway generating plant, to deal with the additional service of cars which the Burton and Ashby Light Railway calls for, was read, and it was resolved that Mr. Pringle obtain tenders for a 100-kw. continuous current dynamo, to be coupled to the shaft of No. 1 alternator, together with the necessary switchboard and connections for the same. Messrs. Kincaid, Waller, Manville & Dawson, the consulting engineers, have in hand the drawing-up of the necessary specifications for the track work in the borough to couple up to the Burton and Ashby Light Railway.

Royal Society.—The following papers were to be read at a meeting held last evening:—

W. R. Bousfield. "Ionic Sizes in Relation to the Conductivity of Electrolytes." Communicated by Prof. J. Larmor, Sec. R.S.

L. Bairstow and A. D. Alexander. "Explosions of Mixtures of Coal-Gas and Air in a Closed Vessel." Communicated by Prof. J. Perry, F.R.S.

C. Coleridge Farr. "On some Continuous Observations on the Rate of Dissipation of Electric Charges in the Open Air." Communicated by Dr. C. Chree, F.R.S.

New Electrical School at Chatham.—The military authorities are erecting a new electrical school for the School of Military Engineering at Chatham. Hitherto the electrical school has been confined within the barracks of the Royal Engineers, but the new school will be of a very extensive character, and fully up to date. The building is being erected on a portion of the lines just without the Royal Engineers' Barracks and Institute at Old Brompton.

Overhead Cables.—On Wednesday the Postmaster-General answered in the Parliamentary Papers Mr. Martin's question as to whether his attention had been called to the complete wrecking of a city office caused by the fall of overhead cables during a recent fire, and if he would take the steps necessary to secure the public from the danger incidental to the use of collections of cables insufficiently secured. Lord Stanley replied that the overhead cables referred to could not have been Post Office cables, because the Post Office, had none in the City. Wherever such cables are used by the Post Office care is taken as far as possible to secure the public from danger.

Appointments Vacant.—Competent electrician for the Hereford County and City Asylum; electrical engineer for Bermondsey Council (£425).

Institution Notes.—The official circular of the Tramways and Light Railways Association for March contains a notice of a proposed visit to the Metropolitan Electric Tramways on Thursday, March 30th; and of Mr. G. A. Trube's lectures on "Brakes." A report of the annual meeting, on February 10th, is given, and of Mr. Herbert Jones's lecture on the "Waterloo and City Railway" (with diagrams), with the discussion thereon, on February 23rd. The visit to the London United Tramways is described.

The first annual dinner of the Students' Section (I.E.E.) will be held on Thursday, March 16th, at the Holborn Restaurant. All students who are able are particularly requested to be present, and should apply at once for tickets to the Students' Hon. Secretary.

Before the Andersonian Chemical Society, at Glasgow, on 3rd inst., Mr. Allan lectured on "Electrolytic Dissociation."

The annual meeting of the Faraday Society was held on Monday, Dr. Burgin presiding. The annual report states that the membership of the society is now 260. Lord Kelvin has been elected president, and among the vice-presidents are Lord Rayleigh, Sir Oliver Lodge, and Mr. Alex. Siemens. Mr. F. W. Harbore afterwards read a paper on "Recent Developments in Electric Smelting in Connection with Iron and Steel."

Prof. W. F. Barrett, F.R.S., recently lectured in the Blackrock Town Hall, Dublin, under the auspices of the Local Technical Instruction Committee, on "Electric Traction and Electric Lighting."

The thirteenth "James Forrest" Lecture will be delivered at the Institution of Civil Engineers by Col. R. E. B. Crompton, R.E., C.B., on Monday, April 10th, at 8 o'clock, the subject being "Unsolved Problems in Electrical Engineering."

Method of Testing Fire-Resisting Cables.—When putting the statements of cable-makers to the test regarding the fire-resisting qualities of their cables, it should be appreciated that the rubber in a rubber-covered cable must of necessity be of an inflammable nature, and that the fire-resisting properties can only be applied to the outer envelope (of tape or braid, as the case may be), and therefore to plunge a piece of cable bodily into the fire would be to give quite an incorrect impression as to its behaviour under normal conditions, since the rubber would run out at each end and burn readily. If it is desired to properly test the fire-resisting properties of such a cable, the conditions should be made to resemble as closely as possible those which would exist when the cable is fixed in position in a building, where a fire could only attack it in two ways:—(1) By flames impinging upon its outer covering or envelope; (2) By an electric arc being set up within or from the cable itself.

To imitate the conditions first set forth above, the sample should be suspended horizontally over a Bunsen burner, so that the flame could only impinge upon it in the middle of its length. It will then be found that the outer coverings are not affected, and that no indication arises of the cable being affected by the heat until the rubber within the envelope has become so hot as to force its way through it to the surface. The rubber thus brought to the surface will undoubtedly burn; but there should be very little burning, and as soon as the source of heat (the Bunsen burner) is removed, the burning should promptly cease, and the fire should have no inclination to spread.

To imitate the conditions set forth in No. 2 above, a small hole should be cut in the middle of the sample so as to expose the conductor, and an arc set up at such point by means of an arc lamp carbon, when, as above indicated, it should be found that the rubber actually exposed alone will burn; and, on the source of heat being removed or stopped, the fire should die out. The better the quality of the rubber on a cable, the more readily it will burn; nevertheless, Messrs. W. T. Glover & Co., Ltd., who have furnished us with these details, claim that, although in all their rubber cables a high grade of pure fine hard Para rubber is used, their fire-resisting cables will give excellent results when submitted to practical tests.

Electricity at Chatham Dockyard.—An interesting lecture on "Electricity" was given on Saturday to the members of the Dockyard "Smiths' Association" at their meeting-house, "The Old Barn," Chatham. Mr. W. J. Brown, master smith, delivered the lecture, in which he referred to the fact that they were now on the eve of a complete installation of electric power throughout the whole of the Royal Dockyard at Chatham, and already in some departments they were using electricity for driving the machinery and lighting the shops.

Electricity in Gold Mining.—The Mysore Gold Mining Co. in its report for 1904, states that notwithstanding that 18,230 tons more ore were mined and milled, and that a greater extent of development work was recorded, the total expenditure in India and England was £284 less than in 1903. The reduction in the working cost per ton thus apparent is an eminently satisfactory feature of the year's operations, one of the contributing causes being the lower price now paid for the power supplied under the Cauvery electrical power scheme.

WEYMOUTH AND MELCOMBE REGIS CORPORATION ELECTRICITY SUPPLY.

The installation of electric lighting plant at the Weymouth electricity works having recently been completed, a short description thereof may be of interest to our readers.

The contract for the generating plant was awarded to the International Electrical Engineering Co., London, and one of our views shows the four generating sets. The engines are by Messrs. Reavell & Co., Ltd., of Ipswich, two of them being two-crank and two three-crank high-speed engines. The cylinder proportions of all these are identical, so that the parts are interchangeable between all the engines.

It will be remembered that in these compound engines a special steam cycle is adopted (Scott's patent); this steam cycle is really a development of the old "Cornish" cycle, which enables the engines to be made of very simple design.

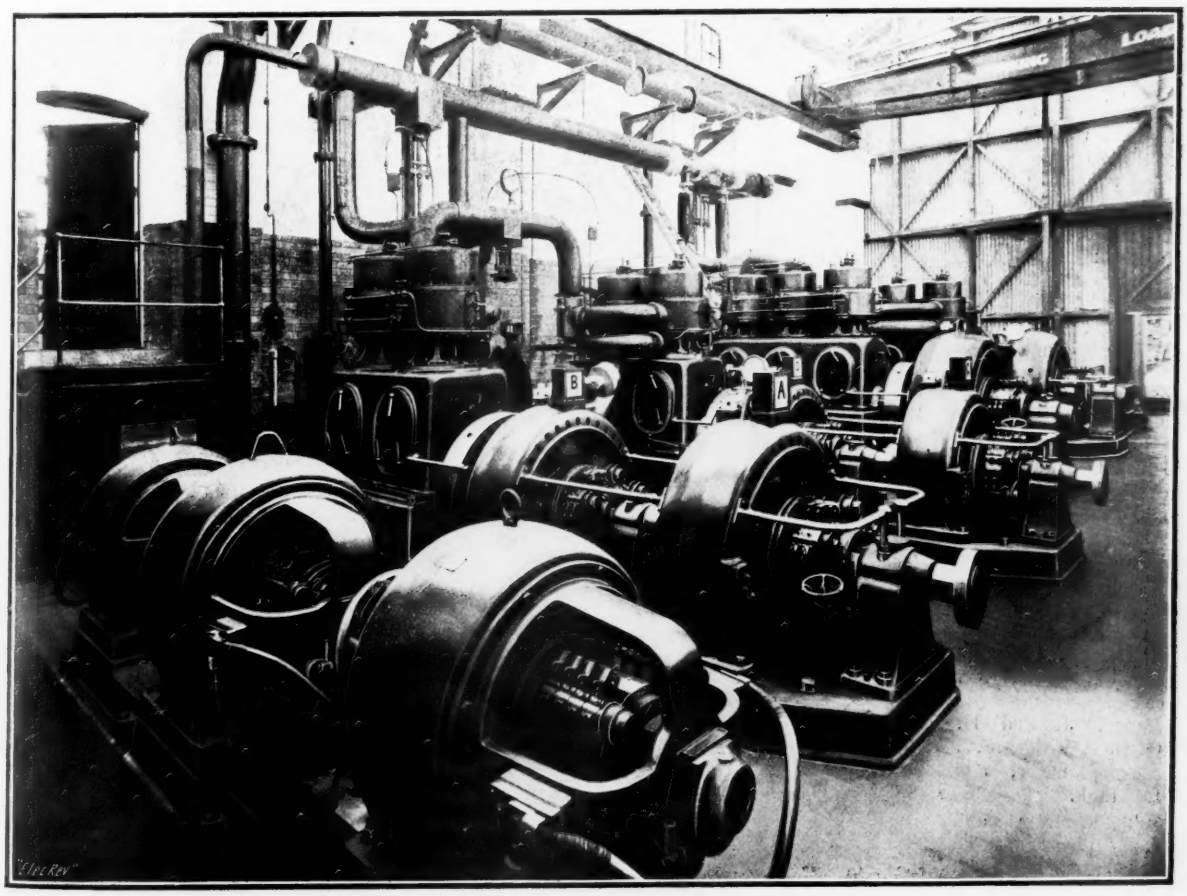
The three-crank engines are designed to give an output of 200 I.H.P., and the two-crank size to give 125 I.H.P. when running at a speed of 425 r.p.m., with 150 lb. steam pressure, non-condensing, and they can be worked condensing when required.

The generators are of the multipolar type, and are six in number. The smaller machines have an output of 37½ KW. at from 230 to 260 volts, and two of these are coupled in tandem to each of the two-crank engines, thus avoiding the use of a separate balancer.

The larger sets have each an output of 122 KW. at from 460 to 520 volts, and are connected across the outers of the three-wire distributing system.

All the dynamos are shunt-wound, and are specially designed for a fixed brush position from no load to full load. Each is provided with a pair of lamps fitted in a box with ground glass front, and connected across the main terminals of the machine, so that the switchboard attendant can see at a glance which machine is working.

J. & P. Cables on the Blackwater Bridge.

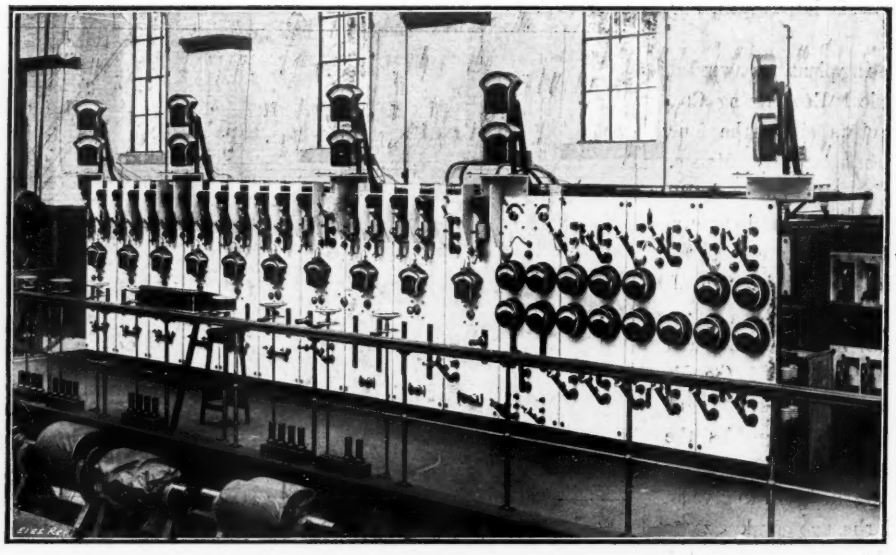


Generating Plant at Weymouth Reavell Engines driving I.E.E. Dynamos.

A motor booster has also been supplied, consisting of a motor driving two boosters, each having a normal output of

133 amperes at 90 volts, the motor being connected to the main bus-bars.

The switchboard was also supplied by the International Electrical Engineering Co., and is shown in the accompanying illustration. It is constructed of marble



Weymouth Electricity Works: Main Switchboard.

panels, securely fixed to a substantial iron frame. The automatic circuit-breakers are of the I.E.E. Co.'s make. The lighting of the switchboard is carried out partly by the use of illuminated dial instruments, and partly by incandescent lamps on projecting brackets. The voltmeters are fixed above the board on swinging brackets, enabling the instruments to be turned through an angle of 120°.

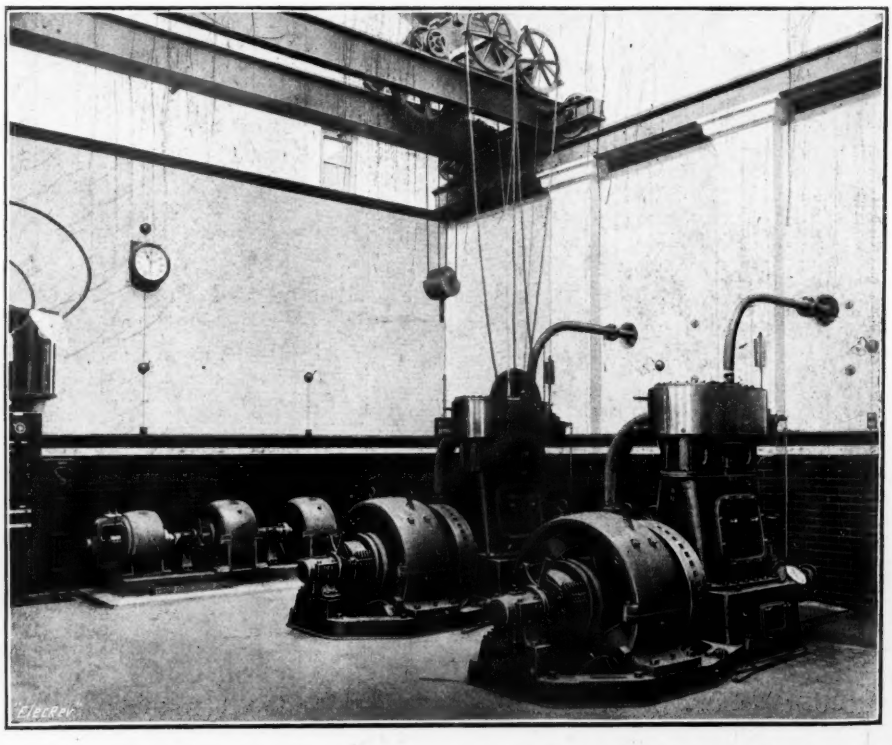
The other plant in the station includes three Lancashire boilers, 28 ft. long × 8 ft. diameter, by Messrs. E. Danks and Co., Ltd., of Oldbury, Weir compound feed-pumps, and Ledward ejector condensers. The whole of the piping—steam, exhaust, feed water, and drain—was supplied and erected by Messrs. Aiton & Co., of Willesden Junction, whose contract included also the feed pumps, an economiser by Messrs. Lowcock, the ejector condensers, centrifugal pumps by Messrs. J. and H. Gwynne, with E.C.C. motors, meter, and feed tank.

The steam and feed pipes are all of weldless steel, with weldless steel flanges screwed on. All branches from the steam range are taken off by means of weldless saddles riveted to the pipes. All low-pressure pipes are of cast-iron. The circulating water pipes are laid in duplicate into the middle of the harbour, and pass through a separate strainer box to the pumps; these pipes are arranged so that either can be used as a suction or as a return pipe, and by reversing the flow from time to time the pipes are kept clear. The pipes in the foreshore were laid by Mr. Vallance, of Weymouth.

The Tudor Accumulator Co. have supplied a three-wire battery of 360 ampere-hours capacity, which is charged and discharged through the boosters, without regulating cells.

Referring to the outdoor work, the mains contract has been carried out by Messrs. Johnson & Phillips, of Old Charlton. About 45 miles of their standard paper-insulated lead-covered cables have been laid in wooden troughing, filled in with refined bitumen and covered with bricks. The positive and negative feeders are made up in one concentric cable, the middle wire feeder being a single cable. All the distributors are single cables. The feeders are of ·25 sq. in. section with ·2 sq. in. middle wire, and the distributors are ·1, ·06, ·1 sq. in. The public lighting cables are laid across the harbour, being specially armoured for the purpose.

All the underground network disconnecting and fuse boxes are of the special "J. & P." pattern with bell covers, not requiring brick pits.



Bridlington Electricity Works: Generating Plant (Allen—J. & P. Steam Dynamos).

The town lighting consists of 1, ½ and ¼-amp. Nernst lamps fed by three-core cables. About 250 of these, complete with standards on wall brackets, have been supplied and erected by Messrs. Johnson & Phillips, who are at present engaged in carrying out the second extension order for lighting the pier, railway station and gardens.

Messrs. Oliver & Co. have supplied 40 arc lamps with lowering gear for the sea front, on posts made by Messrs. J. Allan & Son, of Glasgow.

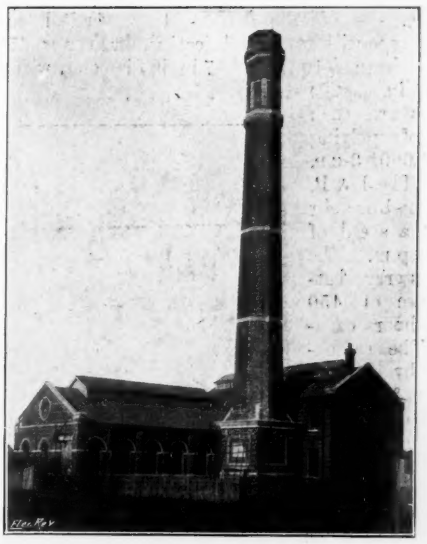
The whole of the plant was constructed and installed under the supervision of Messrs. Kennedy & Jenkin, the consulting engineers for the scheme.

BRIDLINGTON ELECTRICITY WORKS.

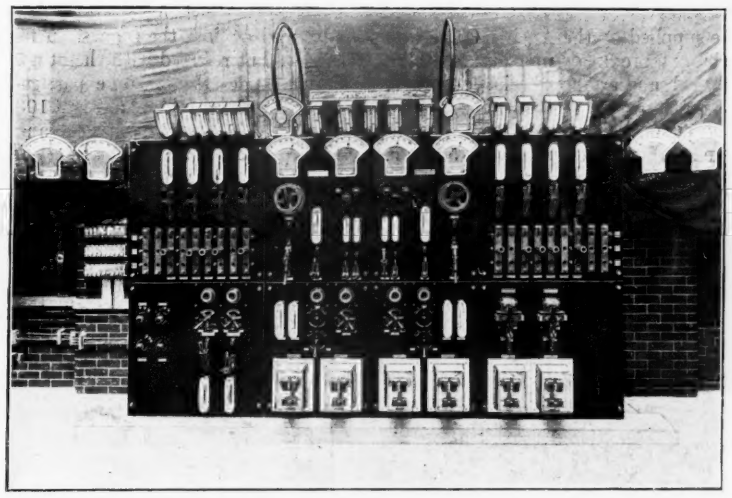
Bridlington, on the coast of Yorkshire, although one of England's ancient towns, is nevertheless one of its youngest boroughs, and has shown no little enterprise in commencing an electrical undertaking on municipal lines. The works were formally opened on the 2nd inst. by the Mayor of Bridlington. With the exception of the electric lighting of the Royal Prince's Parade, there has been hitherto no electrical works in the town, and the Parade has been lighted by a gas-driven dynamo of a type that is now regarded as quite old-fashioned.

Before the district was yet incorporated, the then Urban District Council (in the summer of 1899) received communications from several companies which were desirous of obtaining an electric lighting order for the district. At once there sprang up a spirit of hostility to the idea of a private monopoly, and the Council decided to apply for a Provisional Order on its own behalf. Mr. F. H. Medhurst, of the firm of Messrs. F. H. Medhurst, Page and Lloyd, was invited to report on the whole subject, and the Order was obtained in 1900. In 1902 the matter, which had been in abeyance, was taken up in earnest, and the ceremony of the 2nd inst. marked the fruition of the scheme.

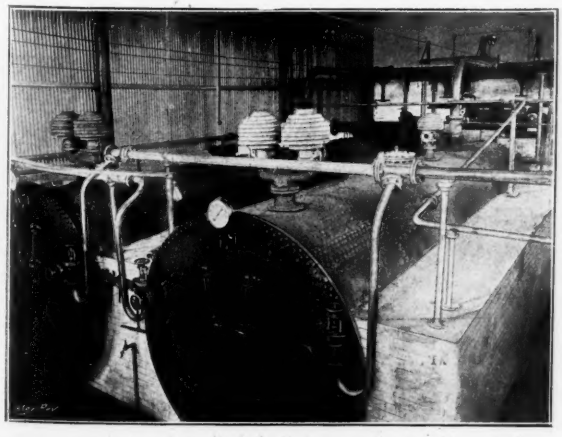
Mr. Medhurst was appointed consulting engineer, and was instructed to prepare plans for a scheme of public and private lighting on the three-wire system, with a pressure of 220 volts at the consumers' terminals. The sanction of the Local Government Board having been received to the borrowing of £26,481, the contracts were placed, and work was commenced.



Bridlington Electricity Works.



Main Switchboard.

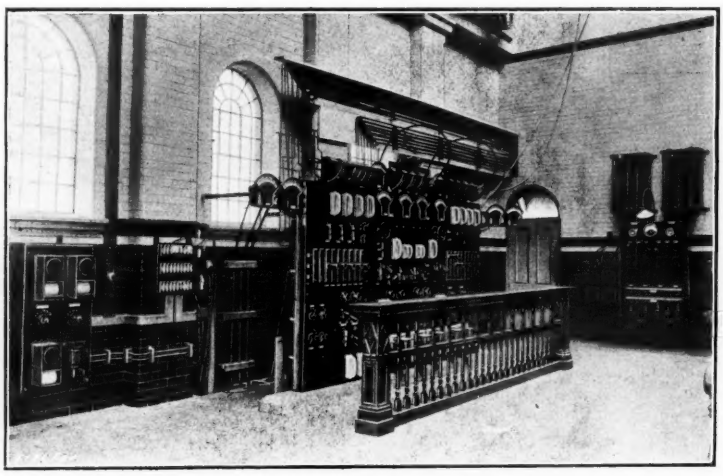


Lancashire Boilers.

A brief description of the building and equipment is given below. The buildings themselves were designed by the borough engineer, Mr. E. R. Matthews, and are situated in a convenient position, affording adequate space for future extensions. The buildings are constructed of red Armitage bricks ornamented with string courses and window mouldings of stone. The chimney shaft is 130 ft. high, of octagonal shape, with a square base. The shaft is built on a block of concrete 23 ft. sq., and 8 ft. thick, strengthened with steel girders. The steam-raising plant comprises two Lancashire boilers, each of which is 7 ft. 6 in. in diameter and 30 ft. in length, and is capable of supplying steam for both the dynamos. The working pressure is 135 lb. per sq. in., but the boilers are constructed to carry 150 lb. The boilers are seated on Poulton blocks; the brickwork is faced with white glazed bricks, and the boiler fittings are of Dewrance's and Turnbull's manufacture. A 96-tube Green economiser is placed in the main flue, and is worked by a 1½-B.H.P. motor. The boiler feed is supplied by vertical compound Hall pumps, each designed to deliver 2,000 gal. of water per hour against a pressure of 150 lb. per sq. in. The steam piping is so arranged that steam can be supplied to either or both the engines from either boiler. The pipes are of mild steel, with welded flanges. The water supply is taken either from the water mains or from a tank, which is supplied from a well by the feed pumps. From the tank it gravitates to the Boby-Chevalet feed-water heater. This apparatus was installed to reduce the hardness of 1,500 gal. of water per hour from 20° or more to 4° of total hardness, and to raise its temperature at the same time to boiling point.

The engine room is 36 ft. long × 32 ft. wide, and presents a handsome appearance. The walls are faced to a

height of 18 ft. with glazed bricks, and the floor is paved with Staffordshire encaustic tiles. The electrical equipment consists of two 100-KW. Allen—Johnson & Phillips steam dynamos of the four-pole type. The engines, each of 160 H.P., are of the double-acting vertical compound enclosed type with forced-lubrication, and run at 475 r.p.m. The cylinders are 10 in. and 17 in. in diameter, with a stroke of 7½ in. The dynamos are each capable of supplying some 4,000 8-C.P. lamps. The J. & P. balancer-booster runs at a speed of 1,000 r.p.m. The E.P.S. storage batteries are of 450 ampere-hours capacity. The switchboard, by Messrs. Johnson & Phillips, consists of polished slate panels fixed to a metal frame, with the usual equipments.



BRIDLINGTON: GENERAL VIEW OF SWITCHGEAR.

There are three feeders from the works connected with the distributing mains, and the aggregate length of all the mains, which were supplied by the Anchor Cable Co., is 30 miles. The distributors are made up of three cables, paper-insulated, lead-sheathed, and armoured with steel tape. The mains are laid direct in the ground. The street lighting consists of 410 incandescent lamps, and 32 arc lamps; 16 of the latter are of 1,000 C.P., and the remainder of 500 C.P. The street lighting is divided into four groups, switched on and off from the works by means of long-range switches. At the time of commencement there were nearly 90 consumers, in addition to the street lighting.

The opening ceremony took place in the presence of a very large assembly. The Town Clerk presented a golden key to the Mayor, and commented on the fact that, although the sum involved might not seem to some of them to be a very large one, yet it represented one-third of the borough's rateable value.

The Mayor accepted the key with thanks, and gave an interesting account of the progress of the scheme since its initiation. He declared that Bridlington was the first town in the kingdom the streets of which were entirely lighted with electric light. The revenue they would so derive being considerable, and there being also a good number of private consumers, he prognosticated that even from the first there would be no loss. He then opened the works, and the party proceeded to inspect the plant.

At a later stage of the proceedings, Mr. J. V. Mainprize, the chairman of the Electricity Committee, prior to connecting-up the town, spoke of the arguments that had been advanced against the suggestion for municipalisation of the supply, but referred with the utmost optimism to the future of the undertaking. The particulars of the contracts he quoted, were as follows:—Two 100-KW. dynamos, balancer-booster set, 10-ton travelling crane and tools, Johnson and Phillips, £2,459; two Lancashire boilers, one Green economiser, boiler settings and flues, Clayton & Son, £1,413; storage battery, 220 cells, Electric Power Storage Co., £1,067; switchboard and connections, Johnson and Phillips, £858; mains (10 years' guarantee), Anchor Cable Co., £9,251; pipework, pumps, and heater, Messrs. J. Spencer & Son, £1,429; street lighting columns, fittings, &c., British Prism Globe Electrical Co., £2,597; buildings, chimney, &c., Messrs. G. Storr & Son, £5,238. After

NATIONAL TELEPHONE COMPANY'S "BANK" EXCHANGE, AFTER THE RECENT FIRE.

wishing the undertaking all possible success, he called on Alderman Johnson and Councillor Andrew to start the engines, which being done he switched on the current, amid applause.

On the evening of the 2nd inst. Mr. F. H. Medhurst, the consulting engineer, entertained the members of the Corporation, officials, contractors, and a number of friends to dinner at the Brunswick Hotel, Bridlington, to suitably mark the occasion.

The photographs used to illustrate this article were taken by Mr. Spurr, of Bridlington.

THE TELEPHONE FIRE.

As briefly noted in our last issue, the National Telephone Co. on the 28th ult. were again the victims of serious fires, which destroyed the test room at their Bank Exchange and a large distributing room at Oxford Court. On the opposite page we give illustrations showing the wreckage of the derrick and the burnt-out test room. Fortunately, the switchboard in the exchange was not damaged except by water; a temporary test-board, which is kept in readiness for such emergencies, was at once requisitioned, and in a remarkably short time a large proportion of the subscribers were re-connected. In a few days, it is hoped, the whole of the connections will be restored.

Unfortunately, a large number of through junctions pass through the Oxford Court distributing room, and the severance of these caused serious difficulty in communicating with the eastern and southern districts. About 6,000 subcribers' stations and 1,000 junctions were cut off by the fire, many aerial cables being destroyed. The disaster is attributed to an accidental contact with the live rail in the tunnel of the Metropolitan District Railway, near Westminster Bridge, the railway company having been carrying out tests on the night of the accident. As it happens, it was the intention of the company to abolish the Bank Exchange this year in any event, and to divide the subscribers between the Holborn and London Wall exchanges; nevertheless, the company merits our sympathy in the serious misfortune which has befallen it. May this be the last of its kind!

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—The Annual Works Dinner of the Croydon Corporation Electricity Works staff was held at the "Greyhound" on Friday, 24th ult., the chief engineer, Mr. A. C. CRAMB, being in the chair, supported by Mr. W. BURR, chief assistant engineer (vice-chairman). A good programme of songs, recitations and instrumental music, was ably rendered by various members of the staff at the smoking concert which followed. During the evening a handsomely fitted travelling bag was presented to Mr. C. W. SALT, who was leaving to take up a higher position at Bradford.

The Birkenhead T.C. has increased the salary of Mr. G. P. SHALLCROSS, assistant electrical engineer, from £225 to £250 per annum.

The Worcester Electricity Committee has recommended the T.C. to vote a gratuity of £21 to Mr. T. H. BIRRELL for extra services in the management of the electricity undertaking between the time of Mr. Sutherland's resignation and Mr. Shaw's commencement of duties.

At the meeting of the Salford T.C., held on March 1st, the recommendation of the Electricity Committee increasing the salary of the electrical engineer, Mr. C. D. TAITE, from £700 to £750 per annum, was negatived by 31 votes to 17.

The Dewsbury T.C. has adopted a recommendation that the salary of Mr. A. P. DRYBURGH, assistant engineer, be advanced from £150 to £170 per annum.

At the offices of the County of Northampton Electric Power and Traction Co., Ltd., Wellingborough, last week, on the occasion of the managing engineer (Mr. H. J. NISBETT) terminating his appointment with this company to take up another similar position at Sheerness, he was presented with a gold-mounted umbrella, together with an illuminated address.

Mr. DUNCAN MCLENNAN, of Glasgow, has been appointed assistant mains superintendent to the Corporation of Greenock.

Mr. VINCENT has resigned his position as borough electrical engineer of Bermondsey. Whoever is appointed his successor is to receive £450 per annum, rising by annual increments of £25 to £600 a year.

At the meeting of the Glasgow T.C. on 2nd inst, the resignation of Mr. W. A. CHAMEN, chief engineer and manager of the Electricity Department, was considered. The Committee, in recommending the acceptance of the resignation, placed on record their high appreciation of the valuable services which Mr. Chamen had rendered to the city during the seven years that he had acted as chief engineer to the Electricity Department. The Committee further recommended that Mr. Chamen's wish to be relieved of his duties at an early date be acceded to. At the meeting of the T.C. Mr. Willock, the chairman of the Electricity Committee, referred to Mr. Chamen's resignation. When he came to Glasgow their capital was £150,000, and after seven years it was £1,300,000. To put it in another way, their revenue seven years ago was £45,000, and this year it was £190,000. He had also built two magnificent electric lighting stations for the Corporation, and the department had now got beyond the stage where the carping critic troubled them. They wished him success in his new sphere.

At a meeting of the Electricity Committee of the Glasgow T.C. on Tuesday afternoon Mr. LACKIE, chief assistant, was appointed chief engineer of the department in succession to Mr. Chamen. Mr. Lackie's salary is at present £500, and it was raised to £800, rising to £1,000. The Committee further decided to ask the T.C. to sanction the appointment of Mr. PAGE (at present Mr. Lackie's junior) as chief assistant at a salary of £500.

On Friday last, on the recommendation of the Lighting Committee, the Islington Borough Council resolved:—"That, owing to the manner in which Mr. PERCY E. RYCROFT has discharged his duties as works engineer, he be promoted to the position of chief assistant electrical engineer at a salary of £300 per annum."

It was announced at a meeting of the Wigan T.C. on March 1st, that Mr. THEODORE PARTINGTON, engineer-in-chief of the Pemberton station, had resigned his position. The Electric and Tramways Committee, it was stated, had decided to put the Pemberton station under the sole control of Mr. SLEVIN, the borough electrical engineer, and the resignation was a sequel.

Certain charges which having recently been brought against the professional "competency" of MR. H. D. MUNRO, city electrical engineer, in the Exeter City Council meeting, we wish to draw attention to the Committee's expression of opinion on the subject which appears among our "Lighting Notes" to-day.

Tramway Officials.—The appointment of manager of the Newcastle-on-Tyne tramways has been secured by Mr. ERNEST HATTON, general manager of the Salford tramways. The salary is £700 per annum.

The Manchester T.C. has appointed Mr. HANCOCK, principal clerk in the Traffic Department, at £180 per annum, as parcels superintendent at a yearly salary of £250, and Mr. J. EADES, jun., car works manager, at £250, has been appointed rolling stock superintendent at £350 a year.

Mr. N. A. BELL, accountant, in the Tramways Department of the Glasgow Corporation, has been appointed chief accountant in Lisbon under Mr. Clark, who left Glasgow a few years ago to take over the management of the Lisbon Tramways. Mr. Bell will receive a salary of £400 per annum.

Mr. WM. GRANT, who has acted as manager of the Rotherham Municipal Tramways since their inauguration, has been appointed tramway manager at Ayr by the T.C. There were 80 applicants for the post.

The West Ham Council at its last meeting passed a recommendation of the Electric Lighting and Tramways Committee to increase the salary of the tramways manager (MR. H. E. BLAIN) by £50, with a further increase in August next of £50, and a third increase in February, 1906, of a further £50.

General.—Mr. J. H. DOBSON, formerly an apprentice in Crewe Railway Works, has been appointed to the Professorship of Electro-technics at the Transvaal Technical Institute, Johannesburg. Mr. Dobson matriculated at University College, Liverpool, was afterwards appointed head of the engineering department at Gamble Institute, St. Helen's, and last year went to South Africa with Prof. Hele-Shaw.

Mr. W. STEUART, of the firm of Messrs. Steuart & Fenn, Ltd., electrical engineers and contractors, New Zealand, is in this country on business connected with electrical work in New Zealand. Communications may be addressed to him at 3, Kensington Gardens Square, London, W.

On 1st inst., at St. John's Church, Stanmore, Mr. FREDERICK A. CORTEZ LEIGH, of the firm of Messrs. Lacey, Sillar & Leigh, was married to Dorothy, only daughter of the late Sidney Humbert, of Watford.

At the National Telephone Co.'s offices at Norwich, on 18th ult., the staff assembled to present a walnut smoking cabinet to Mr. F. M. HALL, chief inspector, who is leaving the service owing to ill-health. Mr. Hall has been with the company for the past 10 years.

The Council of the Royal Society recently decided to recommend 15 gentlemen from the list of candidates for election into the Fellowship of the Society. The following are among them:—Mr.

F. C. G. Searle, senior demonstrator at the Cavendish Laboratory, Cambridge, and author of numerous papers on electric and magnetic problems, including a method for testing the magnetic properties of iron and steel; the Hon. R. J. Strutt, Fellow of Trinity College, Cambridge, an original investigator in physics, on questions such as the dispersion of the cathode rays by magnetic force, the behaviour of the Becquerel and Röntgen rays, and the discharge of electricity through argon and helium.

A private message from West Orange, N.J., states that Mr. Thos. Alva Edison is better. He is now able to visit his laboratory, and is expected to be entirely recovered from the effects of his recent operation in about six weeks' time.

Obituary.—Mr. Norton P. Otis, chairman of the Otis Elevator Co., died at Yonkers, N.Y., on February 21st, aged 65.

We learn with sincere regret of the death of Mr. Stephen William Silver, whose name is inseparably connected with the "Silvertown" company (the India-rubber, Gutta-percha and Telegraph Works Co., Ltd.). Death occurred on 7th inst. from a relapse after congestion of the lungs. Mr. Silver had reached the advanced age of 86 years.

NEW COMPANIES REGISTERED.

Electromobile Hiring Co., Ltd. (83,703).—This company was registered on February 25th, with a capital of £8,000 in £1 shares, to let out to hire, sell, and deal in electric and other motor-cars and carriages, and to carry on the business of automobile store and garage keepers, motor repairers and cleaners, suppliers of electricity and other motive power, &c., and to adopt two agreements with the Electromobile Co., Ltd. The first subscribers (each with one share) are:—G. Cockerton, 7, Curzon Street, W., secretary; A. Colquhoun, 27, Oppidans Road, N.W., clerk; A. P. Hall, 140, Long Acre, W.C., clerk; H. Joly, 32, South Parade, S.W., electrical engineer; E. N. Ruddock, 23, Palace Road, Streatham Hill, S.W., engineer; J. Stewart, 118, Farringdon Road, E.C., book-keeper; W. C. West, 85, Mornington Cresent, Regent's Park, N.W., clerk; and T. G. Chambers, 7, Curzon Street, W., managing director. No initial public issue. The first directors are Lord Westbury and T. G. Chambers. Lord Westbury may retain office so long as he holds 3,000 shares. T. G. Chambers may retain office while the Electromobile Co., Ltd., holds 3,000 shares. Remuneration (if any) as fixed by the company.

Webster Electrical Engineering Co., Ltd. (83,637).—This company was registered on February 20th, with a capital of £10,000 in £1 shares (5,000 6 per cent. cumulative preference, 4,000 preferred ordinary and 1,000 deferred ordinary), to take over the business of an electrical engineer carried on by C. W. Webster, at Laycock's Mill, Thornton Road, Bradford, and to adopt an agreement with the said vendor. The first subscribers (each with one preferred ordinary share) are:—F. W. T. Newbould, Ivy House, Shipley, Yorks, wool merchant; W. M. Gray, District Bank Chambers, Bradford, chartered accountant; C. W. Webster, Laycock's Mill, Bradford, electrical engineer; J. T. Webster, 750, Manchester Road, Bradford, traveller; W. Morgan, 23, Bank Street, Bradford, solicitor; J. H. Haley, District Bank Chambers, Bradford, incorporated accountant; and A. E. Stringer, District Bank Chambers, Bradford, incorporated accountant. No initial public issue. The number of directors is not to be less than two nor more than seven: the first are C. W. Webster (managing director) and F. W. T. Newbould; qualification, 50 shares; remuneration of managing director, £3 10s. per week; of other directors, as fixed by the company. Registered office, Laycock's Mill, Thornton Road, Bradford.

Light Electric Motor Co., Ltd. (5,792).—This company was registered in Edinburgh on February 21st, with a capital of £6,500 in £1 shares, to purchase the business of manufacturers of electrical specialities, electric power and light contractors, &c., carried on under the style of "The Light Electric Motor Co.," at 164, Howard Street, Glasgow, and to carry on the same. The first subscribers are:—J. Maclean, 164, Howard Street, Glasgow, consulting electrical engineer, 3,500 shares; D. Laurie, Belhaven, Myrtle Avenue, Lenzie, merchant, 1,500 shares; G. Rowland, 54, East Street, Horsham, Sussex, builder, 1,000 shares; R. Craig, Cherryhill View, Larkhall, tailor, 100 shares, J. Clelland, Union Street, Larkhall, merchant, 100 shares; H. D. Fitzpatrick; 100, Wellington Street, Glasgow, patent agent, 100 shares; and W. Callender, 100, West Regent Street, Glasgow, solicitor, 1 share. The number of directors is not to be less than two nor more than seven; the first are J. Maclean, G. Rowland and D. Laurie; qualification, £100; remuneration as fixed by the company. Registered office, 164, Howard Street, Glasgow.

International Dowsing Electric Heating and Appliances Co., Ltd. (83,693).—This company was registered on February 24th, with a capital of £20,000 in £1 shares, to adopt an agreement with A. Romberg, liquidator of the Compagnie International de Chauffage par C'Electricité, to acquire any patents and inventions relating to heating and lighting by electricity for hygienic, therapeutic and general purposes, to carry on any scientific, therapeutic, medical or surgical institution, &c. The subscribers (each with one share) are:—D. Huntley, 70, Loveday Road, West Ealing, electrical engineer; H. J. Dowsing, 24, Budge Row, E.C., electrical engineer; D. MacLaurin, 36, Basinghall Street, E.C., merchant; W. Conolly, Buckhurst, Redhill, gentleman: A. C. Newstead, Abergate, Bromley, outfitter; C. J. Hudson, 7, Bonchurch Road, West Ealing, traveller; and W. Frost, 20, Finsbury Circus, E.C., clerk. No initial public issue. The number of directors is not to be less than four nor more than seven; the first are W. Conolly, A. C. Newstead, H. J. Dowsing, D. MacLaurin, and A. M. Romberg; qualification, £100; remuneration, 10 per cent. of the profits, divisible. Registered office, 24, Budge Row, E.C.

Mansfield & Sons, Ltd. (83,671).—This company was registered on February 22nd, with a capital of £20,000 in £1 shares, to carry on the business of gas, sanitary, hydraulic, civil and mechanical engineers, dealers in apparatus used in connection with the generation, distribution, supply, accumulation and employment of gas, water and electricity, &c. The first subscribers (each with one share) are:—A. Mansfield, 20, Redcross Street, Liverpool, engineer; W. Mansfield, 20, Redcross Street, engineer; E. Mansfield, Whitby, Chester, engineer; Miss C. Mansfield, Whitby, Chester; Miss N. Mansfield, Whitby, Chester; C. McBride, 12, St. Vincent Road, Egremont, book-keeper; and W. J. Hart, 14, Ridley Street, Oxton, buyer. No initial public issue. A. Mansfield is managing director for life.

Electrical and Hardware Co., Ltd. (83,661).—This company was registered on February 22nd, with a capital of £1,000 in £1 shares, to manufacture and deal in electrical and other lamps, bulbs, bells, batteries, toys, novelties, and accessories, hardware, tinware, earthenware, ceramic ware, &c. The first subscribers are:—F. Frohwein, 20, Paper Street, E.C., merchant, with 100 shares; H. Leeser, 25, Cambridge Gardens, North Kensington, W., merchant, 100 shares; A. Baden, 8, Landseer Road, Bow, E., merchant, 1 share; W. Hart, 85, Mann Street, S.E., clerk, 1 share; A. D. Jackson, 754, Little Britain, E.C., merchant, 1 share; W. Webb, 11, Ludlow Street, N., clerk; and E. D. Hunwick, Arbour Villa, Violet Road, South Woodford, clerk. No initial public issue. The subscribers are to appoint the first directors; qualification, £100.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Auto-Electric Rifle and Target Co., Ltd., London (76,336).—Issue, on February 8th, of a debenture for £50, part of series created December 5th, 1904, to secure £5,000, charged on the company's undertaking and property, present and future. No trustees. No previous issue of same series.

Mutual Telephone Co., Ltd. (56,627).—This company's annual return was filed on February 7th, when 6,283 preference and 10,348 ordinary shares had been taken up out of a nominal capital of £250,000 in 20,000 preference and 30,000 ordinary shares of £5 each. 6d. per share has been called up and £1,184 7s. 6d. has been received, including payments in advance of calls. Mortgages and charges: Nil.

Municipal Electric Light and Power Co., Ltd. (29,021).—This company's annual return was filed on January 13th, when 37 ordinary and 30 founders' shares had been taken up out of a nominal capital of £25,000 in 2,490 ordinary shares of £10 each, and 100 founders' shares of £1 each. £10 per share has been called up on the ordinary and £1 on the founders' shares, resulting in the receipt of £400. Mortgages and charges: Nil.

Moelline Co., Ltd., electric and general engineers, London (76,689).—Issue, on January 17th, of £250 debentures, part of series created December 28th, 1904, to secure £5,000, charged on the company's undertaking and property, present and future, including uncalled capital (if any). Holders: City of London Contract Corporation, Ltd., 3, Tokenhouse Buildings, E.C. No trustees. No previous issue of same series.

Eastern Telegraph Co., Ltd. (6,338).—Issue, on February 8th, of £5,000 debenture stock, being the whole of a series created by resolution of even date, constituting a first charge on the company's undertaking and revenue. Holder: C. Robertson, 108, Gloucester Place, W. Debenture stock previously issued and ranking *pari passu* with this series: £1,882,704.

Kalgoorlie Electric Power and Lighting Corporation, Ltd. (63,248).—A memorandum of satisfaction in full of a charge dated July 10th, 1902, securing not more than £10,000, has been filed.

Chiswick Electricity Supply Corporation, Ltd. (38,854).—Issue, on January 17th, of £200 debentures, part of series created November 2nd, 1900, and March 8th, 1901, to secure £50,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: Miss H. Heybourne, Clive Cottage, The Warren, Manor Park, Essex. No trustees. Previously issued of same series: £33,500.

ELECTRICITY SUPPLY ACCOUNTS.

Walsall Municipal Electricity Supply.

The Walsall returns for 1904 show a continuation of the previous year's prosperity. During the year electric traction called for some three-quarter's of a million units; and, as a result, the output of the station nearly doubled. Under improved conditions the working costs fell more than ½d. per unit, and after meeting all financial charges the department completed the year with a handsome balance in hand of over £1,000. The previous year's balance, some £70, was added to the reserve fund, which, however, as yet only totals some £176. The department is to be congratulated on the satisfactory result of the past year's working.

The prices charged are:—Private lighting, 6d. and 2d. per unit, maximum demand system, or 4d. flat rate; power, 2d. to 1½d.; and traction 1½d. per unit. The chief engineer is Mr. Alex. Wyllie.

General Statement.

For year ending December 31st—	1904.	1903.
Total capital expended	£86,406	£78,572
Number of units sold—		
Private supply	423,192 }	593,121
Traction	707,654 }	
Public lighting	34,392	29,708
Total number of units sold ...	1,165,238	622,829
Equivalent No. of 8-c.p. lamps connected	46,038	34,535
Number of public lamps	19	19
Maximum load in kw.	754	521
h.p. of motors connected	220	177
Revenue account—		
Gross revenue	£12,109	£8,384
„ expenditure	£6,792	£5,498
„ profit	£5,317	£2,886
Average price obtained per unit—		
Private supply	3·66d.	3·93d.
Public lighting	3·50d.	4·00d.
Traction	1·76d.	1·92d.

Revenue Account for Year ending December 31st, 1904.

Gross revenue	£12,109 =	2·5d. per unit.
Works and distribution costs (including public lighting)	£5,316 =	1·09d. „
Total working costs	£6,792 =	1·40d. „

Profit Statement, 1904.

Interest on loans, &c.	£2,233
Sinking fund	2,023
Balance carried forward...	1,061
Gross profit	£5,317

Aberdeen Municipal Electricity Supply.

We have again to record a very satisfactory year's work for this Scottish undertaking. The contributory causes to the department's successful business in 1903 were largely responsible for its substantial maintenance in 1904. The traction and motor loads are largely increasing, the department having acquired a new consumer in the Aberdeen Suburban Tramways Co. The growth of the motor load in the city can be gauged from the following figures:—

Year ending July 31st,	1900	42,326	units.
„ „	1901	67,244	„
„ „	1902	137,486	„
„ „	1903	275,038	„
„ „	1904	388,570	„

In the result the department made a gross profit of £21,000, as compared with £16,000 at July, 1903, and after meeting statutory charges a balance of nearly £10,000 remained. The latter sum was allocated as to £6,320 to depreciation, and the remainder (including £278 received for sundry services rendered to the tramways department) to the reserve fund, which now totals £13,430. We congratulate the engineer, Mr. J. Alex. Bell, on the very sound position of his department.

The prices charged are:—Private lighting, 6d. and 2½d. per unit; power, 3d. and 1d.; and public lighting, 6d. and 2d., one hour maximum demand; traction, 2½d. per unit, Suburban Co.; 1·354d. per unit, Corporation Tramways.

General Statement.

For year ending July 31st—	1904.	1903.
Total capital expended	£220,743	£194,079
Number of units sold—		
Private supply	1,581,900	1,274,790
Public lighting	258,803	217,212
Traction	1,698,314	1,085,306
Total number of units sold ...	3,539,026	2,577,308
Equivalent No. of 8-c.p. lamps connected	154,000	126,327
H.P. of motors connected	1,719	1,160
Number of public lamps	289	281
Load factor	19·4	17·4
Maximum load in kw.	2,080	1,557
Revenue Account—		
Gross revenue	£38,210	£29,875
„ expenditure	£17,136	£13,963
„ profit	£21,074	£15,912
Average inclusive price obtained per unit—		
Private supply	3·7d.	3·7d.
Public lighting	2·6d.	2·6d.
Traction	1·38d.	1·64d.

Revenue Account for Year ending July 31st, 1904.

Gross revenue	£38,210 =	2·59d. per unit.
Works and distribution costs	£12,621 =	·85d. „
Total working costs	£17,136 =	1·16d. „

Profit Statement, 1904.

Interest on loans, &c.	£7,398
Sinking fund	4,003
Balance on year's working...	9,951
Sundry amounts received during year	—278
Gross profit	£21,074

Assessment of a Yorkshire Electric Light Works.—Although the premises were still in the hands of the contractors, and would not be in working condition for some time to come, the new generating station of the Yorkshire Electric Power Co. at Thornhill, near Dewsbury, was some time ago assessed at a rateable value of £1,200. We understand that the company thereupon sought the advice of the Machinery Users' Association, with the result that their valuer, Mr. Humphreys-Davies, appeared before the Assessment Committee last week, and obtained a reduction of the rateable value from £1,200 to £10, until such time as the station should be profitably occupied.

CITY NOTES.

Henley's.

We confess to feeling a little uneasy as we left the meeting of W. T. Henley's Telegraph Works Co. on Monday last. There is a difference of opinion among the directors as to the dividend declaration. Now, we do not doubt that it can often enough happen that one director may stand alone in his advocacy of some particular course that he regards as being good for his company, but knowing that the majority of his colleagues are unable to see eye to eye with him, he does not find it incumbent upon him to let his objection be known outside the door of the board-room. Henley's, however is not a case in point. The unfortunate fact here is that the view that 15 per cent. is too large a dividend is expressed by the managing director, who, more than any other member of the company, should know the working of the company, its outlook, and its responsibilties, and he has thought fit to make his opinion public. Mr. Sutton, it is true, did not suggest that the course proposed by the board should be departed from by the meeting, and a smaller dividend be declared; the difference is not so acute as that. Apparently he is personally convinced that, in view of prevailing circumstances, the company would have done better to pay 12½ per cent., and keep more money in its coffers for what the future may bring forth. And certainly no one would have been surprised had the directors' recent announcement been to that effect, for the lower interim dividend of last year, coupled with lessening profits and increasing prices of raw material, naturally led one to believe that there might be a drop; 1904 was a year of lower dividends, and Henley's would not have suffered very seriously in reputation had that experience been theirs, especially if it made for continued stability of the company. There appears to be no room for doubt that the dividend of 15 per cent. was earned, and earned on a capital which had become enlarged by the new work's outlay. The electrical trade, as Mr. Sutton says, is decidedly improving, and the company is receiving its share of the increased business. But the new works cannot become revenue-earning before the autumn. While we agree that it is never good policy for a manufacturing company to divide its profits up to the hilt, and while we can appreciate the desire of Mr. Sutton for placing the permanent soundness of the concern before the payment of big dividends, we may hope that the cause of the managing director's fears will be removed by the coming of greater industrial activity and better paying business. For the present, however, we do not feel that we can regard that 15 per cent. for 1904 without some misgivings.

City of London Electric Lighting Co.

On Wednesday afternoon at Salisbury House, Mr. J. B. Braithwaite, junr., presided over the meeting of this company.

In moving the adoption of the report (Elec. Rev., March 3rd, p. 365), the Chairman said that the forecast of last year that an additional dividend would be paid this year had been borne out, mainly due to the satisfactory working of the staff. They were able again to go through the year without any increase of capital, and he trusted they would be able to go on without adding materially to the capital, unless their Bill was carried. They were putting to reserve this year £45,500, which was more than was being paid to the ordinary shareholders. That was a conservative policy with which he felt they would all agree. With regard to the revenue account, they had received £221,671 from the sale of current, which was an increase of £10,500; revenue under contracts was nearly the same, being £13,449, against £13,277; meter rentals had gone up, and so had rents receivable, owing to the company having let the premises they had acquired for a transformer station. The total revenue was £255,087, as against £242,101 last year, being an increase of about £13,000. Their sales of current last year were 17,624,110 units, as against 14,806,449 units last year, an increase of 2,800,000 units. Perhaps the best means of enabling them to grasp the economies which had been brought about by the engineering staff, was to point out what was the cost of these additional units generated. The total cost of this was inside £1,000, or in other words, seventy-six thousanths of a penny per unit. It showed how the increase of output brought down the cost of manufacture, and the result was that in the cost of generation the coal figure had come down from ·4439d. in 1903, to ·4001d. They had made a further satisfactory increase both in the number of customers and the number of lamps connected. They had increased their customers by 361 and the lamp connections by the equivalent of 87,000 8-c.p. lamps. The net result of all the operations of the past year was that they had earned an extra 1 per cent. on the ordinary shares without diminishing their contributions to the reserve fund or to depreciation, and still carrying the same amount forward. The price they were getting for their current continued to fall, and the fact that they had had to meet this decrease in price and still give an extra 1 per cent. showed the success which attended the efforts made by the staff to reduce the cost of manufacture. They had only received about 3½d. on the average for their current, which showed a reduction of

nearly ½d. as compared with last year. No doubt he would be expected to say something with regard to what was known as the great £5,000,000 power scheme now before Parliament, which had been so much boomed in the papers. They naturally were watching the shareholders' interests very closely in the matter, and were taking all the necessary steps to oppose that scheme, and without leading them to be unduly sanguine, he felt that they had some reasons to believe that their efforts would be successful. It would seem most inequitable to companies like their own—which had borne the heat and burden of the day, and spent large sums of capital on the faith of provisional orders granted by Parliament, and had had imposed on them very great obligations to supply the man who burnt his lamp for only a few hours—if Parliament then allowed anyone to come along and take the long-hour load, which was the pick of the load, and was the cheapest to supply. The promoters of this power scheme did not propose to take any responsibility for the supply of light, but simply wished to supply in bulk for power purposes, and to authorised lighting undertakings, and further they asked that no purchase clause should be inserted like those which applied to the existing companies. The bait they held out was that they would be able to supply more cheaply, but his own belief was that this was fallacious. He did not see how the promoters were going to buy coal cheaper than their company, and they could not put in more efficient machinery than the City of London Co. had. Further, their works were close to their customers, but the promoters of the new company proposed to erect a generating station some way from London, and if so they would have loss in transmission. In addition, while it was true that a generating station for 50,000 H.P. could work more economically than one for 3,000 H.P., yet there was a point beyond which it was no economy to increase the size of a station. He, personally, believed that the figures which had been placed before the public by the promoters of the scheme were fallacious, and he felt that the existing companies could do as well. At all events, if their power load was taken away it would mean increasing the price for lighting, and that would not be for the public interest.

Mr. F. W. Reynolds seconded the motion, and it was carried.

South London Electric Supply Corporation.

The directors' report for the year ended December 31st, 1904, says that after making a full allowance for depreciation and preliminary expenses, the net balance is £21,884, from which must be deducted interest on borrowed capital, which absorbed £2,437, leaving a balance of £19,447. Out of this the board recommend the payment of a dividend at the rate of 4 per cent. on the ordinary shares for the year, carrying forward a balance of £6,447. The number of 8-C.P. lamps connected on December 31st, 1904, was 107,000, being an increase during the year of 15,098 lamps, while applications were in hand for a further 4,200 lamps. In accordance with the information given to the shareholders at the last annual meeting, an issue of £50,000 debenture bonds was made in January of last year, the object being to pay off temporary loans and provide capital for necessary extension of mains and plant. The total number of units sold in 1904 was 9,205,342, being an increase for the year of 4,399,861 units. The plant, machinery, and mains had been maintained in a high state of efficiency out of revenue. The cost of production had again been still further reduced.

Statement of Electricity Generated, Sold, &c., December 31st, 1904.

Board of Trade units generated	9,842,989
Sold to consumers and used by public arc lamps	9,205,342
Quantity utilised—	
Used on works for lighting, meter testing, and motors	195,006
Total	9,400,348
Quantity expended in distribution—	
In batteries and motor alternators	59,863
In feeders	61,681
Transformers	257,327
Total	378,871
Total quantity accounted for	9,779,219
Quantity unaccounted for	63,770
Number of lamps on circuit equivalent in 8-C.P. December 31st	107,000

H. W. Sprunt, *Manager and Engineer.*

County of London Electric Supply Co.

The directors' report for 1904, states that the capital expended during the year under review in respect of the company's London districts amounted to £83,504, making the total expenditure on account of those districts up to December 31st last £1,383,593. The balance from last account was £5,255, and from revenue account (after deducting generation and distribution costs, rent, rates, taxes, wages, directors' fees, general establishment and other charges, and proportion of salaries) £85,279, making a total available revenue for the year 1904, of £90,535; interest on first and second debenture stock, and interest on temporary loans, £32,297; interim dividend on 30,000 6 per cent. preference shares for June half-year, £8,569; interim dividend on 40,000 ordinary shares at 4 per cent. per annum for June half-year £7,617; carried to reserve for depreciation, repairs, renewals, &c. £19,150; total, £67,633, leaving for further distribution, £22,902. Out of this sum the directors now recommend a further dividend on the 30,000 6 per cent. preference shares for the half-year ended December 31st, 1904, and a further dividend on the 40,000 ordinary shares for the half-year ended December 31st, 1904' at the rate of 5 per cent. per annum. These payments will absorb £18,050, and leave a balance of £8,452 to be carried forward.

In October of last year £150,000 4½ per cent. second debenture stock, being the balance of the £400,000 4½ per cent. second debenture stock created, was issued to the company's stock and shareholders at par. Application has been made to the Board of Trade, with the consent of the local authority, for a provisional order for the district of the Croydon Rural District Council, which adjoinsth e company's southern areas. Under the powers of the London Electric Lighting Areas Act, 1904, agreements have been entered into with the Borough Councils of Islington and Battersea for exchange of the overlapping areas affected by the Bill. The company is promoting a Bill in the present Session of Parliament, the main objects of which are:—(a) To enable the company to interconnect its London stations; (b) to obtain compulsory powers for acquiring lands; and (c) to supply energy in bulk to authorised undertakers. The Bill has passed Standing Orders, and now awaits the Committee stage. Various Bills are being promoted in the present Session of Parliament which may affect the company, but the necessary steps are being taken to protect the company's interest. The profits derived from the company's London stations for 1904 amounted to £92,730 19s. 6d., against £78,423 11s. 6d. for 1903, being an increase of 26·29 per cent. for the year, while the percentage of working expenses to revenue from sale of current fell from 50·6 per cent. to 45·8 per cent. The total applications received at December 31st last amounted to the equivalent of 647,711 8-C.P. lamps, being an increase of 118,855 lamps for the year, as against 112,564 lamps for 1903. Included in these figures are 865 users of motors, aggregating 7,811 H.P., showing an increase of 1,974 H.P. for 1904, of which 890 H.P. is in respect of the Wandsworth station. The total units sold were 7,181,309, as against 5,754,633 for the previous year. To meet the growing demand in the company's northern districts additional plant is on order, and will be erected at the City Road station during the current year. The plant erected last year at the Wandsworth station will, it is anticipated, be sufficient for the company's requirements for the immediate future in the southern districts.

Statement of Electricity Generated, Sold, &c.

Quantity generated in B.O.T. units	10,078,411
Quantity sold -	
Private consumers by meter	7,181,209
Total sold	7,181,309
Quantity used on works	657,981
Total quantity accounted for	7,839,290
Quantity not accounted for	2,239,121
Total maximum supply demanded	6,016 KW.

The directors of the Bournemouth and Poole Electricity Supply Co., Ltd., have declared a dividend on the ordinary shares of the company at the rate of 7 per cent. per annum for the year 1904. The business of the Scottish House-to-House Electricity Co., Ltd., shows a substantial improvement on the year's working.

Northern Counties Electricity Supply Co.

The directors' report for 1904 says that the working operations embrace the areas of Blyth, Spennymoor, Alnwick, Hebburn, Thirsk, Whitley, Ashington, Hartlepool, Morpeth, Felling, Malton and Cambois (Bedlingtonshire), the five last-named places having come into operation during the year. The work done shows a substantial increase on the previous year as follows:—

Consumers connected to December 31st, 1904			3,866
Number at beginning of year			2,482
Increase for year			1,384
Equivalent in 8-C.P. lamps connected to December 31st, 1904			88,177
Number at beginning of year			39,639
Increase for year			48,538
Units sold for year ending December 31st, 1904			986,873
Units sold for previous year			344,781
Increase for year			642,092
Gross receipts for current sold for year ending December 31st, 1904		£12,280 12	2
Previous year		4,979 2	1
Increase for year		£7,301 10	1

The directors consider this development entirely satisfactory, and in view of the revival in trade and the steady and increasing demand for power, they expect the ensuing year will show a further large and profitable extension of business. In order to promote the more economical distribution of current and prevent the overlapping of interests in various areas in Northumberland, an arrangement has been made for the working and developing by the Newcastle-upon-Tyne Electric Supply Co., Ltd., of certain undertakings consisting of Whitley, Monkseaton, Earsdon and Seghill. The revenue account, after an apportionment of charges between construction and revenue accounts, shows a credit balance for the year of £4,387, plus balance from last year, £1,001 = £5,388. The directors recommend the disposal of this amount as follows:—Interim dividend already paid at the rate of 3 per cent. per annum (less income-tax), £1,602; final dividend at the same rate (less income-tax), £1,649; amount to reserve account, £1,500; preliminary expenses written off, £380; balance carried forward, £257. The money market being more favourable, it is proposed during the financial year now entered upon to offer the debentures, or a portion of them, to the shareholders at a fair rate of interest, as also the balance of the last issue of shares not yet taken up (14,537 in number).

Newcastle-upon-Tyne Electric Supply Co.

Mr. J. T. Merz presided at the meeting held on the 2nd inst., at the Station Hotel, Newcastle. He said that they had made considerable progress during the year. The total units sold during the year amounted to 17,132,153, as against 9,033,625 units in the year before. The cost had come down to a reduction which equalled nearly one-fifth of a penny. The total revenue of the company had been £108,957, an increase of £32,345 over last year, and the gross profits had been £61,440, as against £42,567 the

year before, and £26,552 the year before that. In two years the gross profit of the company had more than doubled. The company, largely by an agreement with the Northern Counties Electricity Supply Co., had now increased their territory over the greater part of South Northumberland up to Blyth, with the exclusion only of the Tynemouth district and that portion of Newcastle in which they had the right to supply electricity, but which, at present, was adequately supplied by the other company, the Newcastle District Lighting Co. Their customers had increased from 2,460 last year to 3,360 at present. As to depreciation and reserve, the directors had written off £6,000 from revenue, and had transferred from the reserve account to the depreciation account the sum of £25,000, which now left the reserve account standing at £21,255 14s. 10d., and the depreciation account at £131,000. The reserve account had benefited to the extent of £23,469 16s. from premiums received on shares issued during the year, and would further benefit to the extent of £3,516 14s. when the final call on the new shares became payable during the present month. The business of the current year has shown a very satisfactory increase as compared with the same period of last year.

Mr. T. G. Gibson seconded the report, which was adopted.

The Chairman moved that the company confirm a provisional agreement for the purchase of the shares in the County of Durham Electrical Power Distribution Co., Ltd. He went fully into the details of the scheme, and justified it by saying that such a business as theirs could only be the more satisfactorily carried on the larger it was. The Durham company supplied a large output of electricity in Gateshead, Jarrow and Durham City and owned prov. orders for other districts in the county. Their own company had largely supplied it with the electrical energy it required; but the development in the County of Durham had not been carried on upon the same scale as on the north side of the Tyne. The scheme would mean a closer relationship between the companies, and the control of the Durham company becoming vested in a new board of directors, the majority of whom were directors of the Newcastle company, the interests of both companies would be largely promoted and extended. Briefly, the sum to be paid was £256,000; but this was subject to considerable deductions upon the final adjustment of liabilities and assets. For example, the sum of £50,000 in cash, representing expenditure on various works now in progress, would be refunded by the Durham company when the work was completed. They preferred to carry on this business as an independent company, and they proposed that it should come to the public, and issue the capital it required. They considered, for the full expansion of the business of the company, that the capital should be £350,000 in ordinary and preference shares, and, if the scheme were passed that day, a prospectus would be issued in the name of the Durham Distribution Co., and the capital offered at par. Their own shares, as they knew, stood at a premium, and this arrangement prevented any depreciation which might occur if they carried out the new issue on their own account.

Chatham and District Light Railways Co.

Mr. A. R. Monks presided at the annual meeting held on Tuesday at 83, Cannon Street. The report, of which we gave an abstract on page 324 of our February 24th issue, was adopted. The report contained the following comparative table:—

Half-year ended.	Miles open.	Passengers carried.	Traffic receipts	Average fare.	Car-mileage.	No. of cars.
June 17, 1902, to Dec. 31, 1902	8·53	3,001,017	£13,614	1·08d.	346,322	25
June 30, 1903	8·53	3,944,522	12,362	·88d.	384,221	35
December 31, 1903.. ..	8·53	4,201,619	15,776	·90d.	451,988	35
June 30, 1904	8·53	3,187,519	14,532	1·09d.	400,762	35
December 31, 1904	9·33	3,459,119	15,946	1·10d.	416,865	35

Yorkshire Electric Power Co.

The half-yearly meeting was held at Leeds, on February 28th, Mr. A. G. Lupton presiding. In moving the adoption of the report for the half-year ended December, 1904 (Electrical Review, February 17th, page 277), he said that they had no revenue account, and, therefore, the accounts were very simple. There was last year an item of £20,200 of fully-paid shares, which had since been increased to £30,300, due to an issue of 1,010 shares to Messrs. Callender & Co. in payment for cables, and there had been a call of £2 a share on the ordinary shares. At the last meeting he said that the directors anticipated having the full plant in working order by the end of the year. It had not been possible to do that, and they had not yet got the turbines running. The station and its equipment was all complete with that exception. The first of the turbines had been tested at the makers' works, and passed a very satisfactory test. It was now being erected at Thornhill, and in about a fortnight would be ready for running. The second turbine would be ready for testing in about a fortnight at Rugby. In order to keep their promise of supplying current in December, the engineer was able to run the subsidiary plant, and current was available at the station on December 30th. The first permanent consumer was connected on January 21st, and since then the supply had gone steadily forward. The second consumer to be connected was a colliery, which had taken a supply since January 29th. They had settled agreements now with consumers to the extent of over 900 H.P. He was confident that by the end of the year they would have doubled that H.P. The directors had given very careful consideration to a scheme for hiring out motors to consumers.

The report was adopted.

London United Tramways (1901).

The meeting of this company was held at the offices, High Road, Chiswick, W., on the 28th ult., Mr. Charles T. Yerkes in the chair.

In moving the adoption of the report, which was published in our last issue (page 364), the Chairman said it was a satisfaction to be able to point to an increased revenue and at the same time a decrease in the working expenses. The total receipts amounted to £296,235 11s. 2d., against £280,241 16s. 1d. in the corresponding period of the previous year, an increase of £15,993 15s. 1d.; while the working expenses were £176,188 5s. 10d. as compared with £176,391 12s. 7d. last year, a decrease of £203 6s. 9d. The percentage of working expenses was 59·47 per cent. against 62·94 per cent. last year, a decrease of 3·47 per cent. The total number of passengers carried during the year was 48,126,727, showing an increase of 2,833,254. With regard to the heavier charges this year for interest and preference dividend, the report referred to certain capital outlays on road improvements and widenings and explained that those works had been deemed expedient for two reasons. One was that the directors desired to obtain forthwith the greatest possible facilities for the conduct of the traffic by the conversion of single and interlacing lines to double track; the other reason was that the acquisition of the properties necessary for carrying out those improvements, if deferred to a later date, would probably have involved a much heavier expenditure owing to the rapid appreciation in value of land and properties on the routes of the company's tramways. Already the company had derived much benefit from the conversion to double track of a number of lengths of single line on the Hampton Court route. For some time after the opening of the line, it was necessary to run the cars in one direction only on Sundays and holidays, at no small inconvenience to the public, and loss of revenue to the company. He was glad, however, to be able to say that now, as a result of the extensive road improvements which had been effected, the cars were at all times run in both directions, and the company was in a position to cope satisfactorily with the greatest pressure of traffic. The capital outlays which had been made increased the interest and preference dividend charges very substantially, but the directors were confident that it would not be long before the company reaped the full benefit in a speedier development of the business, and a corresponding increase in the revenue. The traffic receipts, he was pleased to say, showed every sign of a steady increase. The company had let a contract for advertising on their cars, which would realise the sum of at least £5,000 per annum. The report also showed how their working had now been standardised so as to secure the maximum of economy consistent with efficiency, and he could fairly prophecy that in future there would be little, if any, increase in the ratio of working expenses, but rather a decrease. Since their last meeting, the line from Southall *vid* Hayes and Hillingdon to Uxbridge, and also the connecting line from Hammersmith Broadway *vid* Askew Road, had been put successfully into operation, and the result of the working of those lines since June last had fully realised their anticipations. The directors believed that a very large development of traffic would now rapidly take place along the fine stretch of country between Southall and Uxbridge. The company had now 37 miles of electric tramway in operation, against about 30 miles last year, and he begged to call the attention of the meeting to the fact that there was no increase in expenses when the number of miles was increased. The directors were concluding contracts for the building and equipment of the authorised extension of the system in Kingston, Surbiton, the Maldens, and Wimbledon, and between Brentford and Hanwell. The work of construction would be proceeded with forthwith, and it was expected that the lines would be completed and put into operation during the course of the year. Those new lines would link up important centres of population, putting them in through communication with the rest of the company's system, and with the London County Council's electric tramways system at Tooting, and would, no doubt, prove to be valuable sources of income to the company. As the report showed, they were spending large sums annually in maintenance and renewals. Everything was renewed out of revenue as the occasion arose, and the whole of the company's permanent way, plant, and equipment, was maintained at the highest standard of efficiency, and in that way depreciation became practically a negligible quantity. The electrification of the District Railway was now rapidly approaching completion, and with the inauguration of the other tube railways controlled by their allies, the Underground Electric Railways Co. of London, and the introduction of through fares and facilities, their electric tramways would be a very considerable factor in that most up-to-date and comprehensive scheme of city and suburban transit. It was with justifiable pride that the directors could say that their system stood in the first rank of electrical undertakings, and their central power station had become one of the "show" installations of the United Kingdom. It had been visited by nearly every scientific society, and described by every technical journal of importance in the land. The Bill promoted by the company in the last session of Parliament to authorise an extension from Hounslow to Staines received the Royal Assent on August 15th last. The Bill in this session merely dealt with the extension of the time limited by their Acts of 1901 and 1902 for the construction of tramways and the acquisition of additional land. In conclusion, he said that they looked forward with every possible confidence to the result of their next year's operations.

Mr. Lloyd remarked that there had been a good deal of talk lately about motor-'buses.

The Chairman said that he did not think they could compete with the trams, though they might take the place of horse-'buses.

The motion for the adoption of the report was carried unanimously.

Mr. Henry Brown, of Spiers & Co., was then elected a director in the place of Mr. Samuel White, who had, the Chairman said, decided to retire.

Mr. Yerkes remarked that he intended to resign his position as chairman of the company. He was now chairman of the Underground Co. and also of the District Co., and he did not think it advisable that he should hold the three offices. He did not intend to retire from the board of directors, and he would always be willing to give the company the benefit of his advice and assistance. It had been deemed advisable to increase the number of directors to seven instead of five, and he moved that the directors be empowered accordingly.

This was agreed to after the Chairman had said that during the past two months there had been an increase of £3,056 in receipts, as compared with the same months of last year. When a company just opened lines there was generally no money made for, as a rule, three years. He believed that they would be making money on their new lines even by next year.

Edwards Air Pump Syndicate.

Mr. C. W. Williamson Milne presided at the meeting held last week. After briefly referring to the accounts, he said that in the electrical trade, municipalities and others had had to restrict their expenditure considerably, so that there was not the same amount of work going during 1904 as in previous years. The company had had many repeat orders. The royalty earnings were still increasing. The foreign business had shown progressive growth. The pump had now replaced the ordinary type almost entirely. Mr. Leslie Robertson seconded the adoption of the report (see Electrical Review, February 24th, p. 322), and it was agreed to. A final dividend of 10 per cent. was declared, making 15 per cent. for the year.

Hart Accumulator Co.

Mr. G. W. Kidd presided at the annual meeting held at Stratford on March 1st. He said that during the year competition had been as keen as—in fact, keener than—ever, and trade depressed throughout the country. The company had, however, been very busy, indeed, during the greater part of the year night shifts had to be run in order to carry out the work in hand. Their premises were not nearly large enough to carry out the work which came their way, so that they had to employ labour continuously in an unprofitable manner. More room would thus mean economy in that direction. The balance-sheet was better than it looked. The stock had been written down to scrap prices. During the year they had installed 16 central station batteries. They stood well in the direction of motor-car business. The staff was continually experimenting in that direction. They had one car which ran something like 5,000 miles before a penny had to be spent on its battery. The orders this year were just about the same as last year, and the sales for January and February showed an increase of 33 per cent. over the same months of 1904. In regard to capital, they must have another £10,000 in order to finish the whole of the buildings. In the accounts, depreciation had been made on the whole of the plant and buildings to the fullest extent.

The report, which was published in our issue of February 24th, p. 321, was adopted, and a 12½ per cent. dividend approved. The re-election of directors and auditors having taken place, votes of thanks to the engineer and manager (Mr. E. J. Clark) and the staff, also the directors, were passed.

W. T. Henley's Telegraph Works Co.

Mr. Sydney Gedge presided at the meeting held at the offices in Blomfield Street, E.C., last Monday. In moving the adoption of the report (Electrical Review, March 3rd, p. 367), he said that they were again asking shareholders to sanction a 15 per cent. dividend, and having regard to the general, commercial and industrial depression which had not yet entirely passed away, and to the fact that the capital upon which the dividend had to be paid (both preference and ordinary) had been increased by one-seventh, he thought they would have no reason for commiserating each other. Their hope was that they would be at least able to maintain that dividend. Competition still continued, but they hoped to hold their own partly by the aid of their new works and by continuing to give as good work as possible. Of course, mistakes were sometimes made; there were flaws in their work as in others, but their object was never to scamp the work. Various circumstances had delayed the completion of the new works, and he was afraid another six months would elapse before they would be able to earn any money. The 15 per cent. dividend was paid on the larger capital, but a part of that capital would not be earning anything until, say, next autumn. They were, therefore, paying dividends on capital which was not earning them. That made the 15 per cent. the more creditable. In place of the late Sir H. M. Stanley, they had elected Mr. Finch, C.I.E., to the board. That gentleman had special qualifications for peculiar work not in London, and he was at present engaged thereon. After referring briefly to the balance-sheet, the chairman mentioned that last year there was a flaw in the cable near the Florida end. It had to be taken up and repaired at a cost of £4,264, which reduced the cable reserve fund to £4,000. This happened 13 years after the laying of the cable. In seven years more the company's liability would run out, and they might consider themselves very fortunate that so many years had elapsed before any money was spent upon the cable.

Mr. George Sutton, managing director, in seconding the adoption of the report, said that the balance-sheet was an uneventful one this year. The year had been one of industrial depression, and the cable trade particularly had felt that depression. They had a capacity of production in this trade far in excess of the demand, and, of course, that meant a great struggle to get business, and a corresponding reduction in profits. That was not a closed chapter. He would not prophesy about it, but during the first two months of this year, the trade of the country so far as electrical industry was concerned, was reviving. They were getting more orders and more inquiries, and they had reasonable ground for hope that the current year might be a better one for trade than the past year. The competition had brought a great deal of anxiety to the management. It was not merely low prices that had prevailed, but high prices for raw material as well. Sometimes during the year they had had to pay more for raw materials than ever before. They had been hit both by lower selling prices and higher costs. The year, though full of anxieties, had, he considered, been very successful. Although it was not the year of the largest dividend and the largest profits, it had been the most successful trading year that the company had ever had, taking all the circumstances into consideration. He was not entirely in accord with the majority of the directors with regard to the dividend that had been recommended for acceptance. He had thought that a less dividend—looking at all the circumstances of the company, the future, and the engagements that the company was entering upon—of, say, 12½ per cent., would have been a welcome one to the shareholders. He did not propose to ask that meeting not to pass the recommendation of the board. The dividend had been earned, it had been announced, it could be paid, and a dividend recommended by the board should be paid. With regard to the reserve, this was invested in the business of the company, and that meant that every thousand pounds that was put to reserve account required £1,000 less to be borrowed for share capital. He thought that when a company could pay reasonable dividends, the cost of the extension of its operations should, as far as possible, be paid out of revenue.

A question having been asked by a shareholder respecting the method of taking stock, was answered in some detail by Mr. Sutton, who, in the course of his reply, mentioned the fact that the amount of floating copper that they had probably ran at between 300 and 500 tons, representing some £25,000 to £35,000.

The report was adopted unanimously.

Resolutions approving the 15 per cent. dividend, re-electing directors and auditors, and thanking the managing director, secretary, staff, chairman, &c., were passed.

British Electric Transformer Co.

The second ordinary meeting of the above company was held on Monday at Salisbury House, E.C., under the chairmanship of Mr. C. Phillips.

In moving the adoption of the report (Electrical Review, March 3rd, p. 365), the Chairman said there were not many engineering companies able to present such a favourable balance at the end of two such bad years as had been experienced since the incorporation of the company. No one could say what would be the result in the future, but they had reason to believe that the current year would prove as prosperous. At all events, the prospects looked very bright at the present time, the orders received since January being far in excess of those received in the same period during 1904. The share capital was of the same nominal amount, but 17s. 6d. had now been paid, instead of 10s. On the credit side they would see the sum of £1,373 in respect of additional patents. Mr. Berry, who had a large interest in the company, had presented them with several patents, which had already proved remunerative, and the board considered it only right to reimburse to Mr. Berry his out-of-pocket expenses. The additions to plant, buildings, &c., £4,711, included the equipment of the two new bays at the works. There was an increase of nearly £2,500 in investments. Part was represented by shares in a company in payment of goods supplied, and the rest in a company with which business had been done, and with a concern by which it was expected the company would benefit. Debts due to the company — £25,159 — appeared a heavy item, but £14,326 of this had been received since January 1st. Their principal customers were corporations and companies working under special Acts of Parliament, and they had no anxiety at all about the balance. As to the profit and loss account, the general charges had been heavy because the business done had been large. The result of the trading was that they had a disposable balance of £13,603, and it was proposed to pay a dividend of 7½ per cent., place £2,000 to reserve and £1,500 to depreciation reserve, write £1,500 off the preliminary expenses, and carry forward £2,494. The £1,500 placed to depreciation reserve was more as a precaution than because they felt such a large sum was necessary, while the sum written off preliminary expenses reduced the item to half what it was two years ago. They could have paid a higher dividend, but felt it more prudent to carry forward a substantial balance than to divide the profits up to the hilt. As to the works, overtime had been worked, and was still being worked, and this, whilst eminently satisfactory from the shareholders' point of view, had entailed hard work on the staff. The increased accommodation offered by the extension of the works had been of great value, and had enabled them to cope with an increased volume of work. They had recently obtained a large order for transformers from the Johannesburg municipality, and other orders from South Africa, America and China, and these would be good advertisements of

their specialities. Competition had been, and was, very keen, and prices were constantly cut, but they had been able to hold their own against their competitors. To show the same profit had, however, necessitated a larger turnover, and he felt that in view of the trade depression the result was very satisfactory. Their orders were now more for transformers for power purposes, and as this meant larger transformers, heavy appliances and machinery had to be installed and the works adapted for a bigger class of work. Mr. Billington, the managing director, had been most indefatigable, and his valuable services were much appreciated by the board.

Mr. A. F. Berry seconded the motion, and said the result was due to the unremitting efforts of the directors and staff. The chairman had told them that he had given the company a number of useful patents. As he was personally very heavily interested in the company, and as the patents worked in admirably with his transformers, the patents of which were held by the company, he was only too pleased to hand them over, and he trusted soon to share some of the profits which might be derivable from these sources.

Replying to questions, the Chairman said there had been no friction between the directors in the past year; in fact, there had not been a single question of a debatable character before the board. They were going to give notice that the unpaid calls must be paid, or the shares would be forfeited. The amount in arrears was not large—only about £500—and was due mainly from one shareholder who could afford to pay. As he had mentioned, over £14,000 had been received since the beginning of the year on account of debts due to the company, and their bank balance was much more satisfactory to-day than at the end of the year. They were quite satisfied with the financial position of the company. With regard to the French company, negotiations were still going on, and he hoped that within the next month or so they would be able to make satisfactory arrangements for the working of the patents in France.

The report was then adopted.

Lanarkshire Tramways Co.

Mr. A. R. Monks presided at the annual meeting held at 83, Cannon Street, E.C.

In moving the adoption of the report (see Electrical Review, February 24th), the Chairman said they were satisfied that they were on a perfectly sure basis, and he had very little doubt that when they met next year, it would be with an enhanced dividend. They were proceeding with the Larkhall extension, and he believed that the contractors would have this ready in the course of June, when a large increase of traffic would result. They had also started a parcel service, and eventually this would be successful. Experience in similar tramways was that it took some considerable time to develop.

The Chairman said that he had had communications from some of the company's friends in the district, asking whether they could obtain shares in the company. The position was shortly this, that the promoters and contractors who had for several years found the necessary funds and embarked in the enterprise at great trouble and expense (nearly £200,000), seeing now that the company was quite a successful one, rather desired—not unnaturally—to keep the shares. Still, he believed the contractors appreciated the desirability of having local shareholders, and seeing that extensions were always going on in the locality, would be agreeable to meet them in the matter, and he thought perhaps in the course of a week or two something might be done to gratify the desires of the local public.

The motion was adopted, and the retiring directors and auditors were re-elected.

The report contains the following comparative table:—

Half-year ended—	July 22nd to Dec. 31st, 1903.	June 30th, 1904.	Dec. 31st, 1904.
Miles open	8·66	8·66	8·66
Passengers carried	2,789,112	3,201,150	3,604,464
Traffic receipts	£14,414	£15,960	£18,035
Average fare	1·24d.	1·19d.	1·19d.
Car-mileage	326,960	385,274	464,068
No. of cars	25	25	35

Metropolitan Electric Supply Co.

The directors' report for 1904 says that, in consequence of the sale of the Marylebone portion of the undertaking and the acquisition by the London County Council of Sardinia Street station, the capital expenditure, which, at the end of 1903, amounted to £2,090,763, has been reduced by the sum of £759,152 which had been expended to that date, in Marylebone and on buildings and plant at Sardinia Street. The expenditure during the year on the remainder of the undertaking was £207,971, and the total capital expenditure now stands at £1,539,582. The gross revenue for the year amounted to £306,541, as compared with £281,422 in 1903, being an increase of £25,118. The cost of generation, which in 1903 was £98,593, amounted in 1904 to £86,141, or a decrease of £12,452. The sum of £1,212,000 awarded to the company for the sale of the Marylebone portion of the undertaking (less £10,000 paid into Court pending the settlement of certain questions of title raised by the Borough Council) was received on July 5th. After crediting capital account with the portion of that sum representing the company's expenditure in Marylebone, and providing for certain arbitration and other expenses, there remained in hand, subject to final adjustment, a sum of £662,551, of which £600,000 was paid to the holders of ordinary shares in terms of the resolution of the extraordinary general meeting of July 19th. The balance, £62,551, had been placed to the credit of depreciation and reserve fund. An agreement was entered into with the Borough Council on July 5th for the supply by the company, as agents for the Council, of all electricity required in Marylebone, until the Council is ready to give the supply from its own generating works now in course of erection. The sum of £183,150 awarded to the company, in connection with the compulsory acquisition by the London County Council of the generating works at Sardinia Street, was received on August 8th, and at the same time the new freehold site near Kingsway was conveyed by the Council to the company. After crediting capital account with the original cost of the buildings and plant acquired by the Council, and certain arbitration and other expenses, and setting aside £9,850 to meet the cost of transferring the feeder connections from the old station to a new sub-station in Fisher Street, Southampton Row, there remained, subject also to final adjustment, a balance of £17,357, which has been placed to the credit of depreciation and reserve fund. The directors are of opinion that it would be advantageous to sub-divide the existing £10 ordinary shares into £5 shares, and an extraordinary general meeting will be held immediately after the ordinary meeting to consider, and, if thought fit, to pass resolutions authorising this to be done, and also to double the number of votes attaching to preference shares, in order to preserve the relative voting power between the ordinary and the preference shareholders. The balance at the credit of the revenue account, before providing for depreciation, is £176,837. The directors have set aside £20,000 as an addition to the depreciation and reserve fund, which, with the special additions referred to, now amounts to £216,355, carrying to the credit of the net revenue account the sum of £156,837. This sum, with the balance brought forward from last account and other receipts, makes a total of £170,982, of which, after deducting interest on debenture stocks and loans, dividend on preference shares and other charges, including interest paid to the Borough Council of St. Marylebone, under the agreement referred to, there remains a balance of £108,157. An interim dividend of 9s. per share (being at the rate of 9 per cent. per annum) on the ordinary share capital, amounting to £45,000, was paid on August 9th, and the directors recommend that a further dividend of 11s. per share (being at the rate of 11 per cent. per annum) on such shares be now paid, making a total distribution for the year of 20s. per share, or 10 per cent. This will absorb a further sum of £55,000, and leave a balance of £8,157 to be carried forward to the next account. The total number of 8-c.p. lamps connected at the end of 1903 was 912,000, being an increase of 89,000 during the year. The present number connected is 930,000.

Lancashire Electric Power Co.

The half-yearly meeting was held at Westminster on Tuesday last week, Mr. F. E. Gripper presiding.

The Chairman said that the company was on the eve of commencing operations. The generating station at Radcliffe was practically completed, and in the course of the next two or three months the last portions of the machinery would be erected and running. The company had also started laying mains. It had entered into agreements with the Urban District Councils of Swinton and Pendlebury and Westhoughton, which had agreed to take a supply of energy from the company, and had also requested the company to act as their distributing agents. Negotiations were also well forward with several other Councils. The company had made arrangements to supply various industrial concerns in the county, including a large cotton mill and a large iron works. A point of interest was that manufacturers and others were recognising that the large towns were tending to cripple their business by reason of their high rates. Whereas in former times it was difficult to remove their works to more lightly-laden centres, now that electricity was available at such low rates the local conditions were of much less importance, and by making use of the company they were now able to obtain much more favourable manufacturing conditions than had hitherto existed. By the next half-yearly meeting in August the works should be in complete running order.

Prospectuses.

The Great Northern, Piccadilly and Brompton Railway Co. has this week been before the investing public with £1,200,000 4 per cent. perpetual debenture stock, offered by Speyer Bros. at £97 per cent.

The Charing Cross, Euston and Hampstead Railway Co. has also been inviting offers for £800,000 4 per cent. perpetual debenture stock at £97. Both lists closed on Monday, 6th inst.

Messrs. Wm. Beardmore & Co., Ltd, of Glasgow, have been before the public with a further issue of debentures.

The London and District Motor-'Bus Co, Ltd, is before the public until to-morrow (Saturday) with an issue of 250,000 ordinary shares of £1 each. Three of the directors are connected with electric tramway companies (Mr. A. A. Campbell Swinton, Mr. J. F. Albright and Mr. E. Caillard), Mr. W. Wor Beaumont is the consulting engineer. As the name of the company implies, it is its object to run a motor-'bus service in the London district; 200 such vehicles are to be acquired.

Falkirk Electric Construction Syndicate.—The first statutory meeting was held at Edinburgh on February 22nd. The directors reported that 940 shares of £100 each (£94,000) had been allotted. Of these, 20 shares (£2,000) were allotted as fully paid in consideration of the subscription of £50,000 of the syndicate's capital. The total cash received by the company to date in respect of shares allotted, subject to payment in cash, amounted to £17,200. The total payments had been £15,808.

Hadfield's Steel Foundry Co.—The directors' report for the past year states that the profits amounted to £76,866, and, with the balance from the previous year, there was an available total of £92,107. It is recommended that a final dividend of 2s. per share and a bonus of 1s. 6d. per share be paid on the ordinary shares, making, with the interim dividend paid, 22½ per cent. for the year, and leaving £15,607 to carry forward. The whole of the additional issue of £50,000 ordinary shares offered at £1 10s. premium had been taken, and the premiums added to the reserve fund, making it £195,000.

Scarborough Electric Supply Co.—In their annual report, the directors state that a portion of the tramway lines was finished and opened for traffic in 1904, and this company has been supplying the needful motive power since June last. The terms of the agreement are satisfactory. The capital outlay in 1904 was £16,368, mainly for supply of current to the tramways. The plant has done its work efficiently, and is of a capacity beyond the load it has yet had to bear. The lamps connected on December 31st, 1904, were 53,971, as against 50,203 at the end of 1903. The accounts show that after placing the sum of £1,500 to depreciation account, there is a balance on revenue account of £5,648. The directors recommend that a dividend be paid at the rate of 6 per cent. for the year, which will absorb £5,143, leaving £505 to be carried forward to 1905. A reduced scale of charges came into effect on January 1st, 1905.

Change of Name.—The style and title of Charing Cross and Strand Electricity Supply Corporation has been altered as from 8th inst. to the Charing Cross, West End and City Electricity Supply Co., Ltd., in accordance with the special resolution recently passed.

Notting Hill Electric Lighting Co.—The annual meeting of this company was held on Tuesday, Sir W. Crookes presiding. Our report is held over until next week.

Direct Spanish Telegraph Co.—The board has decided to pay in addition to the dividend at the rate of 10 per cent. per annum on the preference shares, a dividend at the rate of 4 per cent., free of income-tax, on the ordinary shares, both for the half-year ended December 31st last, and payable on April 1st, 1905.

Stock Exchange Notices.—The Committee has appointed Tuesday, March 14th, as a special settling day in—

Havana Electricity Co., Ltd.—Scrip (fully and partly paid) for £150,000 5 per cent. debentures.

And ordered the undermentioned securities to be quoted in the Official List:—

City of Buenos Ayres Tramways Co. (1904), Ltd.—243,708 shares of £5 each, fully paid, Nos. 1 to 241,671, 243,656 to 244,142, and 246,451 to 248,000, and £174,000 4 per cent. debenture stock, in lieu of the shares and debenture stock of the City of Buenos Ayres Tramways Co., Ltd., now quoted; Havana Electricity Co., Ltd.—Scrip (partly paid) for £150,000 5 per cent. debentures.

Bournemouth & Poole Electricity Supply Co., Ltd.—Further issue of 4,500 ordinary shares of £10 each, fully paid, Nos. 22,501 to 27,000; and £80,000 4½ per cent. debenture stock.

Western Telegraph Co., Ltd.—Further issue of £44,435 4 per cent. debenture stock.

Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to—

Henley's (W. T.) Telegraph Works Co., Ltd.—Further issue of 5,000 ordinary shares of £5 each, fully paid, Nos. 35,001 to 40,000.

Davis & Timmins, Ltd.—The report for 1904 states that the net profit, including £3,461 brought forward, after allowing for depreciation and commission to managers, was £13,444. The directors recommend a dividend at the rate of 8 per cent. per annum on the ordinary shares for the year ended December 31st, 1904, placing to general reserve £2,000, leaving to be carried forward £4,084.

Hove Electric Light Co.—The report for 1904 states that the result of the year's working has been satisfactory, and the net profits have increased, notwithstanding an indifferent season at Hove, from £11,215 in 1903 to £11,807 in 1904. With the balance brought forward from last year, and deducting debenture interest, other charges, and the interim dividend at the rate of 7 per cent. per annum paid in October last, there remains a balance of £7,471 to credit of net revenue account. The directors propose to place £3,000 to the reserve fund, which will thus be increased to £35,326, to declare a dividend at the rate of 10 per cent. per annum for the half-year, making, with the interim dividend, 8½ per cent. for the year, and to carry the balance, £1,087, forward. The expenditure on capital account during the year has amounted to £5,017, the greater portion of which (£3,344) has been on extensions of mains.

Bank Rate.—The Bank Rate was yesterday reduced to 2½ per cent.

STOCKS AND SHARES.

Wednesday Evening.

In the general markets in the Stock Exchange display some disposition to halt upon their improved prices, certainly the remark does not cover the electrical divisions. In these there is a maintenance of strength, and fresh advances are still the prevailing feature. Only in the electrical supply list is dulness noticeable in more than a couple of examples, and we candidly admit that the slight declines are difficult of explanation, except upon the grounds that the dividends are mostly paid, and there is little left to "go for" until next autumn. The reports and distributions are satisfactory in nearly every case, and the best electric light shares offer a channel for sound investment which it would be difficult to better.

Nevertheless, as already stated, there are a few falls to be found in the Supply department. Westminsters shed ¼ to 13, although the Preference are ⅛ up at 6¾. Chelsea Ordinary dropped the 5s. gained last week, and are back to 7, while a decline of ¼ took Smithfield Ordinary shares to 2⅞. Several shares, however, are better. City of London Ordinary and Preference at 13 and 14 have put on ¼ each, and so have St. James's at 13⅜. Edmundson's Preference at 6¼ are better, and only ⅛ below the price of the Ordinary. County of London Debenture stocks of both kinds are harder. Criticism is still levelled at the inadequate provision for depreciation in the County of London balance-sheet, but the company is evidently bent on reform in this direction. Notting Hill shares at 15 are unaffected by the chairman's speech at Tuesday's meeting, when he stated that the company had enjoyed a record year. Metropolitan Ordinary are up ¼ at 19½, which is still *cum* dividend, but the price will be quoted *ex* next Wednesday, March 15th. Dealers in the electric lighting market are busier than they have been for some months past, and the steady absorption of shares by investors should make its mark felt upon quotations.

Two rises stand out dramatically this week. One is an advance of 60 points in Commercial Cables Trust certificates, which has taken the price from 180 to 235. The stock is being bought for the United States, where the development of the company's energy is perhaps better appreciated than on this side. The second sharp improvement is in British Westinghouse Preference, the price being now 3⅜, or 15s. better than it was when we strongly urged proprietors not to sell their shares two or three weeks ago. The Debenture stock climbed to 91, and British Thomson-Houston Debenture is better at par.

Of Telegraph issues other than Commercial Cables Trust, it may be said that the tone continues strong. Amazon Debentures put on 7½ points at 72½, last week's rise in the shares (the price of which remains at 2) directing attention to the prior stock, of which the market is in short supply. Anglo-American Telegraph "A" has risen 1¼ to 15⅝ upon heavy speculative purchases, and the price is being gaily talked to 20. The Eastern issues have again improved, and Globe Telegraph and Trust are better at 10⅜ and 14⅜ for Ordinary and Preference respectively. Submarines should be amongst the next to move, being but a point better this week at 125½. Great Northerns followed up their rise of a sovereign last week by a similar improvement, being now 32½. Whether the Far Eastern War stops or continues, the Great Northern Co. is expected to do exceedingly well. West India and Panama First and Second Preference dropped 10s. after their recent jump.

Telephone varieties have made further progress, National Deferred being ½ better at 113, Chili Telephones ½ at 6⅜, and Orientals ⅛ at 1 5/16. United River Plate Telephone shares, like Argentine Railway stocks, have suffered not at all at the news that the Republic is to remain under martial law for two months.

No changes have occurred in any of the strictly electric Railway stocks, except for ½ fall in City and South London to 45, but Metropolitan Ordinary at 97 is 1 better, and Districts mark a fractional rise at 42¼. The twin Debenture issues of the Great Northern, Piccadilly and Brompton, and the Euston, Charing Cross and Hampstead Companies were swiftly subscribed, and there is a small premium on both. Baker Street and Waterloo Debenture eased off a trifle to 2¼ premium. The Underground Electric profit-sharing notes are 99 middle.

Traction stocks and shares are steady, with few quotable alterations. British Electric Second Debenture braced up 2 per cent. to 98, and Calcutta Tramways Debenture is firm at 107½. Buenos Ayres National Tramway First Preference are called 7, and an odd amount of 100 shares has been floating round the market on the look out for a buyer. When these get placed, the shares, it is said, will again advance. Belgrano Ordinary are 3⅞, and Anglo-Argentine Ordinary 8½. The remarkable circular issued by Mr. Parrish to his fellow-shareholders in the Cape Electric Tramways Co., has caused a slight fall to 1⅝. It would appear well for proprietors to support Mr. Parrish, and his letter affords some clue to the mysterious falling-away in the price of Cape Electrics, to which we have referred on several occasions. London United Preference are somewhat nominal at 10¼, but the Debenture stock has been dealt in between 102 and 103.

Manufacturing shares give no indication of yielding their lately-acquired advances. Henley's are 10s. up at 13¼, and Callender's rose ¼ to 11¼. Telegraph Constructions recovered the pound lost last week. There is an ⅛ rise in Edison & Swan "A" to ⅞, and in Brush Preference to 1⅝, while Debenture issues find buyers at increasing prices.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1902.	1903.	1904.	Closing Quotations March 1st.	Closing Quotations March 8th.	Business done week ended March 8th, 1905. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	99 —102	99 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¼— 2⅜	2¼— 2⅜	..	..
119,700‡	Do. do. 5 % Debs., Nos. 1 to 1,950 Red.	100	..	..	..	60 — 70	70 — 75	..	..
788,840	Anglo-American Telegraph	Stock	60/6	61s.	2⅝%	60 — 62	60 — 62	60½	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5⅝%	107 —109	107 —108	108	107½
3,105,580	Do. do. do. Deferred	Stock	1/-	2s.	Nil	14½— 14⅝	15⅛— 15⅜	15⅜	14⅜
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	..	6⅜— 6⅝	6⅜— 6⅝	6⅝	..
13,388,800§	Commercial Cable	$100	8 %	..	..	170 —190	230 — 240	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	97 — 99	98 — 100	99⅛	98
16,000	Cuba Telegraph	10	6½%	5 %	..	8¾— 9½	8¾— 9½	9 3/32	8¾
6,000	Do. 10 % Pref.	10	..	..	..	17 — 18	17 — 18	17⅜	17⅜
12,931	Direct Spanish Telegraph, Ord.	5	..	..	..	3⅜— 3⅝	3⅜— 3⅜	3½	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	8 — 8½	8 — 8½	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	100 — 102	101 —103	..	..
60,710‡	Direct United States Cable	20	3½%	3 %	..	11¼— 11½	11⅜— 11½	11 7/16	11 1/16
73,500	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,900, Red.	100	..	..	..	100 —102	100 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	141 —144	144 —147	145½	143½
1,965,555	Do. 8½ % Pref. Stock	100	..	..	..	89 — 91	91 — 93	91½	90½
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	107 —109	107 —109	108½	108
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	..	14 — 14½	14⅜— 14¾	14⅝	14¼
320,000‡	Do. 4 % Deb. Stock	Stock	..	..	..	104 —106	104 —106	105	104
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	100 —102	100 —102	..	..
200,000‡	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	101 —103	100 —102	..	..
180,227	Globe Telegraph and Trust	10	£3 16 7*	5⅛%	..	10⅛— 10⅜	10⅜— 10⅝	10⅝	10⅜
180,042	Do. do. 6 % Pref.	10	..	..	..	14 — 14½	14½— 14⅝	14⅝	14½
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	15 %	..	31 — 32	32 — 53	53	32⅛
50,600	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	100 —102	100 —102	..	..
17,000	Indo-European Telegraph	25	10%	10 %	..	46 — 48	46 — 48	47½	..
72,680	Monte Video Telephone Co., Ltd., Ord.	1	3 %	3 %	..	⅞— ⅞	⅞— ⅞	..	..
1,988,338	National Telephone, Pref. Stock	100	6 %	6 %	6 %	112 —113	112½—113½	113½	112½
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	106 —108	106 —108	107½	106½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5⅛%	5¼— 5⅜	5¼— 6	5⅜	5 7/16
900,000‡	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	4 %	98 — 100	99 — 101	100	98½
689,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	..	104 —106	104 —106	105	104
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6¼%	..	1⅛— 1⅜	1 — 1⅜	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 3/16— 1 1/16	1 3/16— 1 1/16	..	..
100,000	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	98 — 101	18 — 101	..	..
11,889‡	Reuter's	8	5 %	..	..	7¼— 7⅜	7¼— 7⅜	..	..
3,303	Submarine Cables Trust	Certs.	..	..	..	123 —126	124 —127	..	..
58,000	United River Plate Telephone	5	7 %	..	..	7⅛— 7⅜	7¼— 7⅜	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
179,947	Do. do. 5 % Debs.	Stock	..	..	..	106 —108	107 —109	..	..
15,609‡	West African Telegraph, Shares	10	2 %	4 %	..	8 — 8⅛	8 — 8⅛	..	..
30,008	West Coast of America, 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	7/16— 7/16	7/16— 7/16	..	..
150,000	West Coast of America, 4% Debs., 1 to 1,500 guar. by Brax. Sub. Tel.	100	..	..	..	99 —101	100 —102	..	..
967,980‡	Western Telegraph, Ltd., Nos. 1 to 967,980	10	7 %	7 %	..	13⅛— 14	13⅛— 14	13 13/16	13 11/16
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —103	101 —103	103⅛	..
400,000‡	Do. do. 4 % Deb. Stock Red.	100	..	..	..	102 —104	102 —104	..	..
88,891	West India and Panama Telegraph	10	..	..	..	⅞— 1	⅞— 1	1	⅞
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	9 — 9½	8⅞— 9	9⅛	8⅞
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	8½— 9⅛	8½— 8¾	8⅝	..
80,000‡	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	..	..	..	103 —105	103 —105	103⅜	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	4⅛— 5	4⅛— 5	..	..
10,000	Do. do. "A" 6 % Cum. Pref.	10	..	..	..	4¼— 5⅛	4⅜— 5⅛	..	..
800,000‡	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	98 —102	98 — 102	..	..
100,000	British Electric Traction	10	8 %	..	..	9⅛— 9⅜	9⅛— 9⅜	9 1/16	9⅛
100,000	Do. do 6 % Cum. Pref.	10	..	..	..	10⅜— 11⅝	10⅜— 11⅜	11 1/16	10⅛
600,000‡	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	121 —123	121 —123	122⅛	122⅛
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	95 — 97	97 — 99	98⅛	98⅛
100,000	British Insulated and Helsby Cables	5	10 %	8 %	..	5⅞— 6⅛	5⅞— 6⅛	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	6⅛— 6⅜	6⅛— 6⅜	6 3/32	..
60,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	101 —104	101 —104	..	..
60,000	¶Browett, Lindley & Co., Ord.	£1	..	..	..	⅜— ⅝	⅜— ⅝	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	..	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781	2	Nil	Nil	..	½— ⅝	½— ⅝	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	..	1⅛— 1⅜	1⅛— 1⅜	1⅜	1 11/16
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	12 — 15 xd	92 — 95 xd	..	..
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	79 — 82	79 — 82	..	..
85,000	Callender's Cable Construction shares	5	15 %	12½%	..	1⅜— 1½	11 — 11⅛	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	4⅞— 5⅛	5⅛— 5⅜	..	..
90,000‡	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	105 —107	105 —107	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	..	93 — 95	93 — 95 xd	94⅛	93½
494,092	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	..	101 —103	101 —103	..	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	..	83 — 86	83 — 86	..	..
1,130,000	City and South London Railway	Stock	3½%	2½%	2½%	45 — 46	44½— 45½	45½	44½
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	..	..	2⅛— 2⅜	2⅛— 2⅜	..	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	93 — 98	93 — 98	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261	5	Nil	..	..	⅞— ⅞	⅞— 1	..	..
17,139	Do. do. "A" shares, 01—017,139	5	Nil	..	..	1 — 1⅛	1 — 1⅛	..	..
344,028‡	Do. do. 4 % Deb. Stock Red.	100	..	..	..	77 — 82	77 — 82	..	..
100,000‡	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 84	81 — 86	..	..
112,100	Electric Construction 1 to 112,100	10	6 %	4 %	..	1⅛— 1½	1⅛— 1½	1⅛	1 3/32
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	5	..	..	..	2¼— 2⅜	2¼— 2⅜	2⅜	..
82,500‡	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 — 99	97 — 99	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	..	..	9½— 10	9½— 10	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	91 — 96	91 — 96	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	15 %	15 %	12½— 13	13 — 13½	13⅜	12 15/16
200,000	Do. do. 4½ % Pref.	5	..	..	..	5⅜— 5⅝ x	5⅜— 5⅝xd	5 31/32	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	109 —111 xd	109 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	..	..	16 — 17	16 — 17	16⅞	16 3/8
900,000‡	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	12½%	12½%	12½%	5 11/16— 5 13/16	8⅝— 8¾	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	9¾— 10	9¾— 10¼	..	..
37,350	Telegraph Construction and Maintenance	19	20 %	20 %	15 %	34 — 36	35 — 37	36½	..
150,000‡	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101½—103½	102 —104	..	..
540,000‡	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	92 — 94	92 — 94	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st, 1904.)

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share ‡	Dividends for the last three years 1902.	1903	1904.	Closing Quotations Mar. 1st.	Closing Quotations March 8th.	Business done week ended Mar. 8th, 1905 Highest	Lowest
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£5	8 %	10 %	..	10¼— 11	10¼— 11	..	..
50,000	Do. do. 7 % Cum. Pref. ..	£5	..	..	..	10½— 10⅝	10½— 10⅝	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	£100	..	..	..	105 —108	105 —108	..	..
50,000	Charing Cross and Strand Electricity Supply	£5	10 %	8 %	8 %	7⅞— 8⅛xd	7⅞— 8⅛ xd	8⅛	8⅛
70,000	Do. do. do. 4½% Cum. Pref. ..	£5	..	..	..	5¾— 5⅞	5¾— 5⅞	5 9/16	5⅝
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	£5	..	..	..	4⅛— 5 1/16	4⅛— 5 1/16	5 1/32	..
40,000	Do. do. 1903	£5	..	..	..	4⅛— 5 1/16	4⅛— 5 1/16	5 1/32	..
3 0.000	Do. do. 4 % Deb. Stock Red.	£100	..	..	..	102 —104	103 —105	104*	..
44 196	*Chelsea Electricity Supply, Ord.	£5	4½%	5⅛%	6 %	7 — 7⅛xd	6⅞— 7⅛ xd	7⅛	6⅞
15,000	Do. do. % Deb. Stock Red.	Stock	..	..	..	109 —111	109 —111	109	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	£10	5 %	5 %	6 %	12⅛— 13	12⅝— 13⅛	13	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£10	..	..	..	13⅜ — 14	13⅝ — 14⅛	..	..
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	123 —127	123 —127	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	£100	..	..	..	103 —105	103 —105	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£10	4 %	4 %	4½%	9¼— 10	9¼— 10	9⅞	..
20,000	Do. do. do. 6 % Pref., 40,001—60 ..	£10	..	..	..	12¼— 12⅝	12¼— 12⅝	12⅝	12½
400,000	Do. do. 4½% Deb. Stock	..	..	..	..	109 —112	110 —113	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	102 —104	103 —105	104	103½
70,000	Edmundson's Electric Corporation, Ord. Shares	£5	7 %	7 %	..	6¼— 6⅜	6¼— 6⅜	6 7/16	6 5/16
70,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6⅛	6⅛— 6⅜	6⅜	6 5/16
800,000	Do. do. 4½% 1st Mort. Deb. Stock	£100	..	..	..	106 —108	106 —108	107⅜	107
21,000	Kensington and Knightsbridge Electric Ord.	£5	10 %	12%	12 %	19⅜ — 19½	12⅜ — 13½	12⅝	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —104	102 —104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	£8	..	..	8 %	2½— 2⅝xd	2½— 2⅝ xd	2 3/16	..
49,840	Do. do. do. 6 % Pref.	£5	..	..	..	6⅛— 6⅜xd	6⅛— 6⅜ xd	6	..
250,000	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	99 —101	99 —101	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	£10	7½%	8½%	10 %	18⅜ — 19½	19 — 19½	19½	19⅜
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	£5	..	..	..	6⅜— 6⅝	6⅜ — 6⅝	6 13/16	6⅝
290,000	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —115	110 —115	..	..
250,000	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	97 — 99	97 — 99	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	£100	..	..	..	98 —100	98 —100	99½	99½
10,852	Notting Hill Electric Lighting	£10	6 %	6 %	7 %	14½— 15½	14½— 15½	15½	15⅜
59,000	Do. do. 4% 1st Mort. Deb.	£100	..	..	..	102 —104	102 —101	104	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£5	14½%	14½%	14½%	13⅜— 13⅝xd	13⅜— 14 xd	15⅜	13
20,000	Do. do. do. 7 % Pref. 20,001 to 40,000	£5	..	..	..	8¼— 8⅜xd	8¼— 8⅜ xd	..	..
150,000	Do. do. do. 3½% Deb. Stock Red ..	£100	..	..	..	98 —100	98 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£5	2½%	4 %	..	2⅜— 3⅛xd	2⅜— 3⅛ xd	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	£9 — £3	79 — 83	..	..
65,000	South London Electricity Supply, Ord.	£5	..	12½	8 %	4⅛— 4⅜	4⅛— 4⅜	4⅜	4⅛
100,000	South Metropolitan Electric Light and Power Ord.	£1	..	..	..	⅞— 1	⅞— 1	1	..
50,000	(*Late Blackheath and Greenwich* 7 % Pref.	£1	..	..	..	1 3/32— 1 5/32	1 3/32— 1 5/32	1 5/32	1 3/32
100,000	*Dist. E.L.Co.*) 4½% 1st Deb. Stock	£100	..	..	..	107 —110	107 —110	109⅜	..
80,000	Urban Electric Supply, Ord.	£5	..	..	..	5⅛— 5 7/16	5 1/16— 5 7/16	5 7/16	..
80,000	Do. do. 5 % Cum. Pref	£5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	5⅜	..
200,000	Do. do. 4½% 1st Mort. Deb. Stock Red	£100	..	..	..	106 —108	106 —108	..	..
110,000	Westminster Electric Supply, Ord.	£5	12 %	13½%	14%	13 — 13⅛xd	12⅞— 13⅛ xd	13⅛	13
28,141	Do. do. 5 % Cum. Pref.	£5	..	..	..	6⅛— 6⅜	6⅛— 6⅜	6⅜	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, March 8th.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	82/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ,, ...	per ton	£30	..
a	Bleaching powder	per ton	£5 5	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£13	..
a	Benzole (90 %)	per gal.	7/-	..
a	,, (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£23	..
a	Lead, Nitrate	per ton	£25	..
a	,, White Sugar	per ton	£31	..
a	,, Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a	Potassium Bichromate, in casks	per lb.	8d.	..
a	Potash, Caustic (75/80%)	per ton	£19	..
a	Potassium Cyanide	per lb.	7½d.	..
a	Shellac	per cwt.	165/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	,, Crystals	per ton	£8	..
a	Sodium Bichromate, casks ..	per lb.	9¼d.	..
a	,, Cyanide	per lb.	7d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£180	..
b	,, Wire, in ton lots ..	per ton	£168	..
b	,, Sheet, in ton lots ..	per ton	£166	..
b	Babbitt's metal ingots	per ton	£43 to £140	..
c	Brass (rolled metal 2" to 12") basis	per lb.	7¼d.	..
c	,, Tube (brazed)	per lb.	9½d.	..
c	,, ,, (solid drawn) ..	per lb.	8¼d.	..
c	,, Wire, basis	per lb.	7¾d.	..
c	Copper Tubes (brazed)	per lb.	10d.	..
c	,, ,, (solid drawn) ..	per lb.	10½d.	..
c	Copper Bars (best selected	per ton	£80	..

	METALS, &c. (*continued*).		Latest Price.	Fortnight's Dec. or Inc.
g	Copper Sheet	per ton	£80	..
g	,, Rod	per ton	£80	..
e	,, (Electrolytic) Bars ..	per ton	£70 10	..
e	,, Sheets ..	per ton	£87	..
e	,, ,, Rod ..	per ton	£81	..
e	,, ,, H.C. Wire	per lb.	9¾d.	..
f	Ebonite Rod	per lb.	8/8	..
f	,, Sheet	per lb.	8/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	8/-	..
h	India-rubber, Para fine	per lb.	5/8½ to 5/5	..
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	49/11	1/9 inc.
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£12 7 6 to £12 10	5/- to 7/6 dec.
g	,, ,, Sheet	per ton	£14	2/6 dec.
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£7 12 6	..
d	Mica (in original cases) small ..	per lb.	6d. to 1/	..
d	,, ,, medium	per lb.	2/6 to 4/-	..
d	,, ,, large ..	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/1 to 1/3	½d. inc.
p	,, rolled bars & rods	per lb.	1/1 to 1/3	½d. inc.
p	,, ,, strip & sheet	per lb.	1/3	½d. inc.
o	Platinum	per oz.	£2/6	..
e	Silicium Bronze Wire	per lb.	10¼d. to 11½d.	½d. inc.
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£153 to £154	30/- to 40/- inc.
n	,, Wire, Nos. 1 to 16	per lb.	1/7½	..
p	White Anti-friction Metals—			
	"White Ant" brand ..	per ton	£43 to £45	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	6d.	..
j	,, 6 lea. Flax	per lb.	53d.	..
j	,, 8 ply 10 lbs. Russian ..	per lb.	4½d.	..
j	,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j	,, 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£27 7 6	17/6 dec.

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co., *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

Yorkshire Electric Power Co.—From this company we have received a post card on which the results obtained from the first year's working of the Elland U D C. combined destructor and electricity works, and the Bridgend U D.C. distributing station, are set out side by side. Elland has made a loss of about £700, and Bridgend, which takes a supply in bulk from the South Wales Electrical Power Distribution Co, shows a net surplus of £150, and this in spite of a population of 6,100, as against 10,604 at Elland. This should be of interest to those who are now endeavouring to oppose a bulk supply for London, and the excellent power schemes that are, and will shortly be, in operation in the provinces. The Yorkshire Co. has arrangements with the Pudsey Corporation, and the Mirfield and Liversedge U.D.C.'s for bulk supply, and the company's Thornhill station is now available for supplying electrical energy.

Electrical Wiring Contractors.—A correspondent sends us the following cutting, *à propos* of the recent discussion in our "Correspondence" columns. The extract speaks for itself:—

8, OXFORD PLACE, BEXLEY.

CHAS. COTON & CO.,
Late T. B. Green & Co.,
ELECTRICAL ENGINEERS,
SANITARY PLUMBERS,
GASFITTERS AND GENERAL IRONMONGERS.

UNDERTAKERS.

House Agents, and Agents for the Royal Exchange Assurance, Fire, Life, Accidents.

— WE SELL EVERYTHING. —

ACTIONS FOR NEGLIGENCE.

We have occasion, from time to time, to comment upon cases in which charges of negligence are brought against tramway companies, and local authorities who are running tramways. Many of these actions are brought to recover damages for substantial injuries; in some, no doubt, the accident which caused the injury was occasioned either by the negligence of some servant of the tramway proprietors, or by some defect in the working of the tram, for which the owner is properly held responsible. But there must be many cases in which no blame attaches to the tramway company or their servants. Yet in how few is the company successful.

The reason for this is not far to seek. A tramway company is fair game for a speculation action. Let but a jury hear a case in which the plaintiff has suffered a serious injury, and in which the defendants can obviously afford to pay a reasonable sum by way of compensation, and the chances are that some damages will be awarded. These actions run along stereotyped lines. We have the "terrible accident" caused by the gross negligence of the conductor in not stopping the car at the point where the plaintiff wanted to alight; the weeks of alleged pain and suffering; the dislocation of business. The plaintiff's case is generally supported by the testimony of an independent witness—the kind of man who may be seen leaning up against the wall of any public house. With assistance of this kind, officials of the tram company are discredited, and the plaintiff generally has a verdict.

Generally—but not always! Cases do arise in which the fabric of the plaintiff's case is undermined. Such a case has recently come before the courts. It should act as a warning to defendants in this class of action to the effect that however strong the plaintiff's case may seem, it will not stand close investigation.

The facts of the case may be briefly stated. An action was brought by a cycle maker to recover damages from the East Ham Council, in respect of injuries alleged to have been sustained by the plaintiff, owing to the breaking of an electric trolley wire, while he was travelling on the top of one of the defendants' cars. According to the plaintiff's case, he had been, prior to the accident, making some £400 a year by his business. On September 13th, 1903, he left Manor Park to travel to Woolwich on one of the defendants' trams. While seated on the top, and at the extreme left of the car, the trolley wire overhead snapped.

According to the plaintiff's evidence, "The broken wire struck him on the head and shoulder, burnt a hole in his cap and coat, and gave him a shock. The iron trolley pole also struck him." The alleged results of the accident were that the plaintiff almost lost the sight of his right eye; suffered from an attack of locomotor ataxy, which prevented him from earning his living; and could only move his limbs with very great pain. He said that since the accident no one had been able to look after his business; that he did not keep proper books "as he was no scholar." This was a plain and apparently an "unvarnished" story. It was borne out by one witness, who alleged that he saw the accident take place, and by two doctors, one of whom could not say that the locomotor ataxy was caused by a blow. The other, an eye specialist, said that the sight of the injured eye had been slightly affected by an accident in the plaintiff's youth, but that the eye paralysis from which the plaintiff was suffering was probably caused by the accident. So much for the plaintiff's case. Listen to what came out in cross-examination, and in the course of the defendants' evidence!

It appeared that some years before a doctor had reported that the plaintiff's eyesight was defective; that so far from being "no scholar," the plaintiff was able to write and had kept books of account; that although there were many other people on the car no one else was hurt; that the plaintiff had made an affidavit to the effect that "the business is carried on as before, and I attend daily to supervise and assist as far as I can." It also appeared that immediately after the accident the plaintiff told the conductor in charge of the car that he had been struck with a pole, but he did not complain of any shock. The manager of the tramways said it would have been impossible for the pole to hit the plaintiff on the head. An electrician said that to get his cap burnt the plaintiff must have had a shock of electricity which would be absolutely fatal under the conditions stated. Moreover, the plaintiff's head would have been burned beyond recognition. A doctor who saw the plaintiff four days after the accident, said that he then noticed a burned streak on the cap but no holes. Finally, an expert witness, who examined the cap with a glass, said that the cap had apparently been burned in several places on the outside. There was a burn inside the cap which had nothing whatever to do with the other burns. He shared the view that if the burns had been caused by an electric shock death would have resulted.

In the light of these extraordinary facts it is not surprising that the jury found a verdict for the defendant Council. There is one point about this case to which it is desirable to draw attention. The action was not launched until a very considerable time after the accident happened. The report which we have consulted does not state the exact period; but if it was more than six months it is clear that the defendant Council would have been entitled to rely on the Public Authorities' Protection Act, which prevents an action of this kind being brought against a local authority except within the period above mentioned.

We have set out enough of the facts of the above case to show that it was probably decided upon the ground that the plaintiff's story was untrue. It must not be forgotten, however, that tramway companies who use the overhead trolley system are under serious liabilities. By Sec. 55 of the Tramways Act, 1870, a tramway company is made liable for all accidents happening through their act or default, and they cannot raise the defence that they are acting under statutory powers and are, therefore, entitled to protection. (Sadler *v.* South Staffordshire Tramway Co., 23 Q.B.D, 17)

The question then arises—is the breaking of a trolley wire *primâ facie* evidence of negligence? Let us glance for a moment at the B. of T. Regulations with regard to these wires. It is there provided that—"The overhead conductors used in connection with the working of tramways shall have supports, the intervals between which shall not, except with the consent of the B. of T., exceed 120 ft., and they shall be in no part at a less height from the surface of the street than 17 ft., except where they pass under railway bridges." Having regard to these regulations, and also to the general principle that those who suspend wires over a highway must give attention to the safety of the public, it is conceived that the falling of such a wire is *primâ facie* evidence of negligence. Light is thrown upon this legal question by certain American cases. It has been decided in that country that negligence may be presumed where an electric wire, which was normally suspended on poles along the street, was trailing on the sidewalk (Ruddy *v.* Newark Electric Light and Power Co. (1899, 46 Ath. Rep., 116), and where a passenger on a car is injured by the breaking of a trolley pole (Keator *v.* Scranton Traction Co., 1899, 191 Pa., 102). Though the matter is not free from doubt, we think that the cases are sufficiently strong to show that a trolley tramway company are under very serious liabilities, the risks from which can only be minimised either by roofing in the cars, or by an elaborate system of inspection. A recent summons against the National Telephone Co. illustrates the extent of the liabilities to which those who suspend wires over highways may be exposed. It appears that on December 9th the wire was found by an inspector on behalf of the City Corporation hanging down in front of No. 44, Coleman Street. This wire had originally stretched across the road to No. 36, and had evidently, owing to its neglected condition, become detached by a high wind. In falling it did no actual harm, but its weight was 26 lb., and the height from which it fell 60 ft. It was pointed out that this was the first case of the kind brought against the company, that they took every possible precaution, and that an inspector went over all the lines every four months. In spite of this Sir John Knill imposed a fine of £5 with £2 2s. costs. Of course this was a proceeding of a quasi-criminal nature. We cite it merely for the purpose of showing that extreme care is expected from those who suspend wires over highways.

THE "DANGEROUS" TOP-DECK COVER.

Considering the preponderating number of miles of tramway track which, either of necessity or from fashion, has been constructed to a 3 ft. 6 in. gauge, it is surprising that so little—nothing, in fact—has been visible on the surface of the indignation, disgust or fear which one little sentence in the latest memorandum issued by the B. of T. has evoked in the breasts of tramway officials. We believe that the intentions of the Board in this particular matter were not known at all generally until the issue of this revised memorandum, although the identical sentence was contained in the original additional memorandum, issued in June last year, and it seems probable that a general distribution of the leaflet was not made.

Rules and regulations, memoranda, additional memoranda, ancient, modern or revised, are becoming so numerous that it is already a matter of some difficulty for the most diligent and careful man to be sure of his text when referring to the latest requirements of the Board.

The sentence to which we refer reads: "The use of covers for the top deck of cars cannot be approved in cases where the gauge of lines is 3 ft. 6 in. or less."

The last 12 months has never had a week without a statement that some corporation or company was about to try, or had ordered more, or was going to equip the whole of its cars with, top-deck covers, and many of the cars so equipped are running on 3 ft. 6 in. gauge.

This year would have seen many more covers fitted, and within five years it is safe to predict that the cars without top-deck covers would have been in the minority if this little sentence had not been written.

Why should it have been written? Did an inspecting officer suffer from nightmare after travelling over a narrow-gauge line on a canopied car at the enormous velocities permitted by him, and dream that he was clutching a lamp bracket while his feet were trying to find hold among the opposite window panes as the car gradually heeled over and over until, as the heeling accelerated, the car at last overturned, and amidst the crash of breaking wood and splintered glass, the gallant colonel woke and determined then and there that a canopy is a highly dangerous article on a narrow gauge car?

That it must be dangerous is evident from the fact that the Board has issued this veto of its further use. It must be much more dangerous to the public than trolley wires, or gunpowder vans, or a gas-service, for all these have been agencies of death or injury, but are still in common use.

We know that the Board does not decide things on its own knowledge. It is always "advised" that such and such measures are desirable. If the President were asked why canopies are forbidden, he would not give a reason, but would say that "the Board is advised that they are unsafe." Evidently the Board's advisers have access to more public news than the public itself, for there is no record in the files of any newspaper of any accident arising out of the use of top-deck covers on narrow-gauge cars. So far as we know there is not a shred of actual evidence to prove the greater danger of a canopy on the top-deck on an electric car than on the top-deck of the trailer on a narrow-gauge steam-tram line. Canopies are new and terrible things only in the mind of the B. of T. They have been used for years on steam cars, and, from a variety of circumstances, have been adapted only recently on electric cars. But whereas they were used on cars which weighed from 3 to 5 tons, and had that weight distributed more or less evenly over the whole car, so bringing the centre of gravity near the middle height of the car, they are used now on cars weighing from 7 to 12 tons, on which the centre of gravity is much nearer the ground by reason of the heavy trucks and electrical equipment. To a lay mind, therefore, it would seem that a canopy is no more dangerous now than then, if other things are equal. Are other things equal? Not altogether, for the maximum speed of an electric car is higher than the maximum which was usual with the more lumbering steam car. The wind pressure on a standing car cannot have altered, and there is no other factor to consider. The question then remains, is there any danger to be anticipated when top-covered cars run on a 3 ft. 6 in. gauge at a speed of 14 miles per hour, this being the highest speed which we remember the Board of Trade granting? That is the way in which we conceive the advisers of the B. of T. putting the question to themselves; certainly it is the only point which we believe can be worth considering. It is evident that the advisers preferred to take no risks, and thought it wiser to anticipate (wisely or unwisely as the reader likes) danger, even though at the moment of decision there were enough practical examples of freedom from danger running over narrow gauge lines in England to have induced the most conservative of counsellors at least to suspend judgement on a matter which affects the prospects of tramway undertakings and the comfort of the travelling public (and what section of the public does not travel nowadays?) in a marked degree.

It is possible that the advisers of the B. of T. do not realise the extent of the fine which they are inflicting on the former, but they might have done so if they had taken any cognizance of current literature bearing on the subject.

So much does the public appreciate shelter that covers are never put on without earning interest and sinking fund at least. The increased earnings have been stated to be more than 2d. per car-mile, but an additional ½d. only will suffice for a small net profit in many cases, and 1d. will make a welcome addition to dividend or relief of rates. The demand for covered top-decks both from managers and from the public is strong enough evidence for retaining them, and this applies equally to broad and narrow-gauge cars.

Can the B. of T. produce combatting evidence of anything like equal cogency? If so, or if not, they should be pressed to state their case, or to answer that of the traction people, who will have facts culled from experience to bring against theories born in the imagination and reared in the drawing office.

Meanwhile, we would seriously advise managers to push forward the equipment of their narrow-gauge cars with covers, as if the memorandum did not exist; for they may be sure that the B. of T. will take no active steps to uphold their objection, and managers may take any risk there is with a light heart. The objection, having no solid foundation, must have been made for the purpose of averting the smallest responsibility for accidents from the Board—an attitude on which we may be allowed to hold an opinion, although it might be considered rude to state it. Shortly we expect to be called upon to criticise an additional revised memorandum in which horse cars are given the preference over any other for new lines, and are suggested for use on the old ones.

This is an injustice which we may expect the Light Railway and Tramway Association to take up in its increasingly energetic manner.

PARALLEL RUNNING OF ALTERNATORS DRIVEN BY LARGE GAS ENGINES.

By E. KILBURN SCOTT, A.M.Inst.C.E., M.I.E.E.

It is surprising that there should be so much misunderstanding on this matter. The writer some time ago paid a visit to Germany and Belgium, where he had an opportunity of seeing the power stations connected with the Iron and Steel Works of the Phœnix Hütte (Nürnberg engines), Oberhausen Iron and Steel Works, near Düsseldorf (Körting engines), the Ilseder Ironworks, near Peine (Oechelhaeuser engines), and the Seraing Iron and Steel Works (Cockerill engines), besides several engine makers' works.

In these stations the engines varied from 500 to 1,500 H.P., and, except in the case of the last, they were all driving three-phase alternators. They were supplied by blast furnace gas in all cases, and were of the single-crank type (except the Oechelhaeuser) working with two impulses per revolution.

The Oechelhaeuser engines at the Ilseder Works were twin engines, and, owing to the peculiar double-ended construction, had three cranks to each, or six in all, to drive one alternator, an unnecessary complication.

The writer can say absolutely that there is no difficulty whatever in running three-phase generators in parallel when

driven by any of the above engines. At the Oberhausen Works, for example, there were two 1,200-H.P. Körting engines driving Siemens alternators, and two 600-H.P. Körting engines driving A E.G. alternators. The machines ran absolutely in parallel; and, further, they were so situated that it was impossible for the man on the switchboard to see all four engines when synchronising.

In the case of the two largest units, by looking through the poles of the alternators one got the pretty effect of seeing them apparently standing still, or slightly swinging back and forwards, as one engine gained a little on the other; this movement, however, was very slight.

It may be stated as a fact that with any single-crank large gas engine by a maker of repute, in which there are two impulses on the crank per revolution, and where sufficient fly-wheel weight is allowed either in the generator wheel, or better, in the generator wheel plus a fly-wheel, parallel running is quite easy.

Of course, there are points to be remembered; one is, that the "hit-and-miss" method of governing is absolutely no use for such work; it is entirely discredited on the Continent, and Cockerill's have superseded it even for blast furnace blowing engines, where good regulation is not important.

Another point is, that the higher the speed the better is the paralleling; and yet, on the other hand, there appears to be a consensus of opinion that it is well for the engine not to run above 100 r.p.m. on account of wear and tear.

In the actual running of these blast furnace gas engines, the only thing that seems to cause trouble is the result of using water for cleaning the gas; in some cases a certain quantity of it is carried over into the cylinder and gets deposited on the sparking plugs, which have to be then taken out and dried. This is, however, a matter which can be easily rectified.

Two of the A.E.G. alternators, coupled to Nürnberg engines, were of the very neat outer pole type, which enables a very heavy fly-wheel rim to be provided on the alternator wheel, so that no separate fly-wheel is necessary.

All the piston rods and pistons are cooled by water, also all the exhaust valves. A spray of water playing into the exhaust pipe effectually prevents any noise or chance of firing there.

The lubrication of the cylinders is usually effected by a thick block of unrefined petroleum oil called "Mazout." All the bearings and other working parts are, of course, lubricated with ordinary mineral oil.

The engines are always started by compressed air, at about 6 atmospheres for the small engines, and 9 atmospheres for engines of 1,000 H.P. and upwards. They start with absolute certainty, and usually, the gas is turned on after a few revolutions only. The writer saw a 1,000-H.P. engine get up to speed from rest in two minutes.

Regarding the number of men to run the engines taking all the stations together, this appeared to run out at about a man and a quarter per engine, including the foremen. There are no young electricians or pointer dodgers in these stations, just engine runners and a switchboard attendant; the foreman appears to look after the three-phase generators in his odd moments.

The work is practically identical with that of running a slow-running steam engine; indeed, some of the engines, the "Nürnberg" in particular, are surprisingly like steam engines, both in outline and detail. The spares carried are about the same as for steam engines.

The rapidity with which these engines are being adopted by the various iron and steel and other works on the Continent is very significant. Altogether the writer saw two dozen engines of over 500 H.P. either running or nearing completion.

Fancy a power station, such as the one at the Ilseder Works, 240 ft. long and 150 ft. wide, in two spans, generating three-phase current at 10,000 volts, and transmitting it 10 miles by overhead wires to the rolling mills at Peine. I wonder what ironworks in England would have the pluck to take on a job like that.

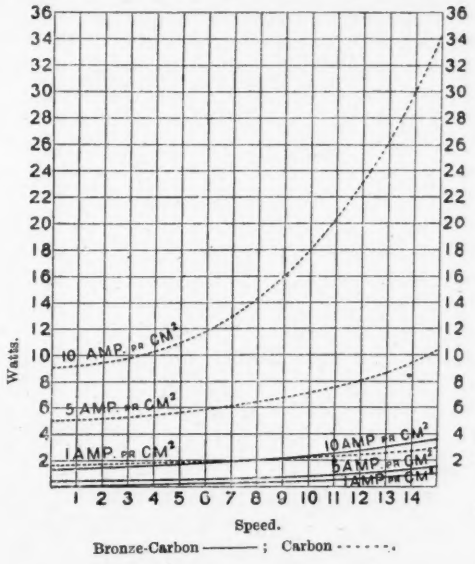
Why, the men who run these Continental works must be themselves electrical experts, for when they lay down a power station it is no half job, but is undertaken with boldness and originality; no nibbling with direct current and petty little machines in a tin shed, but a tip-top first-class station worthy of a large concern.

Fifty years ago, the fathers of the men who run these works used to come to England to see engines and machinery; now the writer and many others are sent over there to report on what they are doing. And there is no mistake about it, the Germans, as a nation, are in training (in the deliberate way an athlete trains) for commercial supremacy. They have had their financial crisis, and learnt the lesson well.

Those amiable old folks whom one sees at Iron and Steel Institute meetings, &c., who are understood to control a fair part of what there is left of our iron and steel trade, will have to look out, if they wish to retain the remainder.

A NEW DYNAMO BRUSH.

Of recent years the tendency in dynamo brush design has been towards the production of a brush combining the sparkless collecting properties of carbon with the high carrying capacity of metal. The *Elektrotechnische Zeitschrift* gives the following particulars of a new brush patented by Messrs. Svenska, of Stockholm, which claims to accomplish this combination. It is known as the bronze-carbon brush, but the mass of the brush does not consist, as the name would seem to imply, of a mixture of powdered bronze and powdered carbon, but of pure powdered graphite, of which each separate particle is first covered with a coating of copper and then with one of tin. The method employed for coppering and tinning the particles is a trade secret. After this process is completed, the powder is hydraulically compressed in a dry and cold state, and without any special binding material, into the required shape. The hardness of the brush can be varied at will during this operation. Afterwards the brushes are heated sufficiently to cause the copper and tin coatings to combine and form a bronze coating. In this way every particle of graphite powder receives a coating of bronze,



Bronze-Carbon ——— ; Carbon - - - - - -.

but the smallness of these particles keeps the material quite homogeneous. It will take a polish and is readily soldered, and also possesses lubricating qualities owing to the presence of about 20 per cent. of free graphite. Tests carried out at the Government Laboratories in Stockholm have proved that the conductivity and the contact resistance of these brushes are the same as those of ordinary plate or gauze brushes. The curves connecting watts lost in ohmic resistance (ordinates) with the peripheral speeds of the commutator in metres per second (abscissæ) at current densities of 1, 5 and 10 amperes per sq. cm. respectively, both for ordinary carbon brushes and for bronze-carbon brushes, are given herewith. The test refers to a 110-volt dynamo, and shows that the difference between the two types of brush is especially marked at the higher current densities. For instance, at a peripheral speed of 15 m. per second and a current density of 10 amps per sq. cm., the loss with ordinary carbons was 34·5 watts, whilst with the bronze-carbon brushes, under the same conditions, the loss was only 3·4 watts.

With regard to sparkless running, it has been found that the bronze-carbon brushes behave as well as pure carbon brushes, and replacing the latter by brushes of the same size and shape, but made of bronze-carbon, does not affect the running of the machine.

The rate of wear of these bronze-carbon brushes is slightly greater than that of metal brushes, but, on the other hand, the wear of the commutator is much less.

RHODES SINGLE-PHASE ALTERNATING CURRENT MOTORS.

The Rhodes Electrical Manufacturing Co., Ltd., which has now been in existence for some 12 years, but only trading under that name for the last three years, is well known as the manufacturer of the R.E. type direct current motor. This machine has undergone various modifications in the shape of alterations to its external appearance, but otherwise has remained the same since it was first designed. It has now been decided to build on the same lines a 1905 type R.E. direct current motor, which will have a larger armature and smaller frame. Experiments have been made in this direction with satisfactory results, and the new motor will shortly be placed on the market.

Being anxious to keep its products up to date, the firm has during the past year sent abroad engineers to investigate the manufacture of A.C. machines, and as a result has now designed two types of alternating

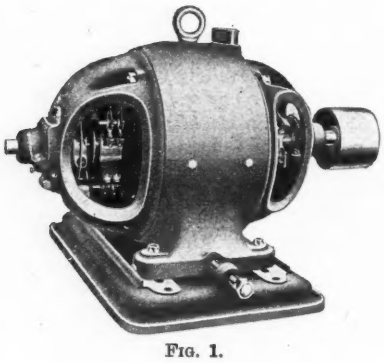


Fig. 1.

current motors, a description of which is given below. Recognising at the outset that the ordinary single-phase induction motor has many disadvantages, such as heavy starting current, low starting torque, and even difficulty in starting, the Rhodes Co. decided to build solely single-phase motors of the slip-ring commutator type, starting up as repulsion motors, and running as induction motors on attaining synchronisim.

This type of motor can be coupled direct to any machine, starts up without the use of a fast and loose pulley or clutch arrangement of any description, and runs at constant speed, so that it possesses most of the advantages of a direct-current motor. Supply engineers, we are informed, have taken kindly to the machine, and the company are at the present moment turning out as many as they possibly can to meet the demand. Their factory has lately been largely extended, and this extension is practically all utilised.

The motors are of two distinct types. The R.X. type is suitable for ordinary stationary work, running in one direction only. This motor is reversible only by altering the position of the brushes on the commutator.

Fig. 2.

The R.F. type, fig. 1, is a similar machine, but has an extra winding which enables the motor to be reversed by simply changing two connections, by means of an ordinary chopper switch.

The external carcase is made of cast-iron, bored out to fit the stator core, which is built up of sheet-iron laminations of high permeability, insulated by paper. The construction of the carcase permits these plates to be pressed into it under hydraulic pressure of more than 50 tons to the sq. in. The special method of assembling employed ensures the inner periphery of the stator being exactly true in the position required. Ample cooling surface is allowed between the outside of the laminations and the frame through a space for air circulation, which runs right round the machine.

The windings on the stator are hand wound, the copper wire being carefully insulated from the core. The rotor is built up in a similar way to the stator, with laminated sheets of iron insulated with paper, mounted and keyed direct on the shaft (which is of ample diameter), under a hydraulic pressure of not less than 70 tons to the square inch, and these are then clamped solidly between two cast-iron end plates which extend as winding drums. The winding employed is similar to that on a bar-wound direct-current armature. Figs. 2 and 3 show the stator and rotor respectively.

A high-pressure test is applied between the windings and iron, on both the stator and the rotor, of 2,000 volts alternating. Although the voltage induced in the rotor is low, the Rhodes Co. apply an equally searching test as that given to the stator in order to minimise risk of short circuits or "earths" in that portion of the machine.

The slip rings are of gun-metal, insulated by a special process and tested with some 4,000 volts to earth. The commutators are built up also under hydraulic pressure, ensuring no loose sections. The company's process of building commutators for their motors makes them almost as solid as a copper ring.

All parts of the machine are interchangeable, and are made to stock in quantities to exact gauges and templates. With this system

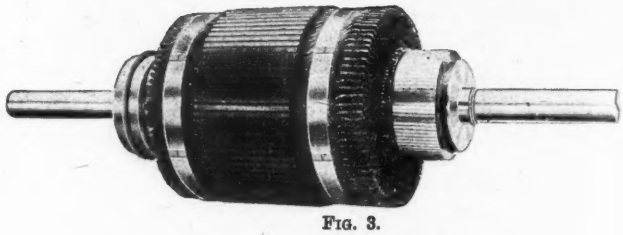


Fig. 3.

quick delivery can be ensured on a large range of windings, and parts of every size are kept in stock.

In fig. 4 the characteristic curves of a 5-H.P. motor are given.

We recently had an opportunity of seeing some of these machines at work, at the factory of Messrs. Waygood & Co., Ltd., the well-known makers of elevators, &c., who have applied a number of the Rhodes A.C. motors to their lifts. One of the machines, rated at 3·5 B.H.P., 50 cycles per second, 400 volts, was run on a brake by Messrs. Waygood for our benefit. The motor had an eight-pole stator, with four brushes on the commutator, and the temperature rise was specified not to exceed 85° F. above the surrounding atmosphere.

Running light at 775 r.p.m., the current was 13 amperes. The motor ran up to speed quickly, without sparking, and very quietly, the only operation required being to throw over a switch when full speed was attained. The normal full load torque was 24·6 lb.-ft.; on holding the rotor stationary by means of the brake, a starting torque of 53 lb.-ft. was registered, with a current of 22·5 amperes. Running with an average torque of 29·2 lb.-ft., at 750 r.p.m., corresponding with an output of 4·16 B.H.P., or about 20 per cent. above normal full load, the current was 14·5 amperes at 433 volts; assuming a power factor of 74 per cent., this gives an efficiency of over 66 per cent., which must be regarded as a very satisfactory result for a motor of this size. The results given were the average of several tests with Messrs. Waygood's apparatus and instruments. Throughout the motor ran without sparking at the commutator, without humming and without vibration. The starting torque, it will be noticed, was 2·15 times the normal full load torque, while the current was less than 1·6 times the full load value.

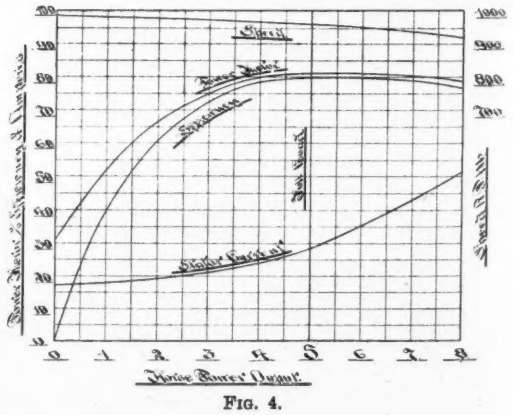


Fig. 4.

On interchanging two of the connections, the motor ran in the reverse direction with equal facility.

The machines are made entirely at the company's works in Bradford, and the Rhodes Electrical Manufacturing Co. claim that they are pioneers in the manufacture of this type of machine in the United Kingdom.

THE KINETIC THEORY OF GASES AND THE STEAM TURBINE.

In an article on this subject in an American journal, the author's ideas appear to be contrary to the usually accepted kinetic theory of gases. The author speaks of the orbital motion of the molecules of a gas, whence it may be deduced very fairly that he considers that the molecules of a gas are so many revolving particles.

The kinetic theory of gases teaches that the molecules of a gas are endowed with motion by virtue of heat energy, and that they possess perfect elasticity and obey the first law of motion, that is to say, being in motion, they will continue to move in a straight line at an unchanging velocity unless and until acted upon by an external force. In an ordinary gas, the free path of the molecule has a length dependent upon the number of molecules occupying a given space; that is to say, in ordinary language, upon the pressure, for, by the same theory, pressure is simply the effect of an extremely large number of molecular impacts upon the circumscribing boundary of the pressure containing vessel. In a vessel under a partial vacuum the free path, that is to say, the average movement of a molecule in space between collisions with any other two molecules, is very much lengthened. If we can grasp the very simple idea of the kinetic theory, we can see why it is that in a partial vacuum two gases will diffuse into each other faster than when under heavier pressure. The free path is longer, and the molecules travel to a greater distance before being turned back by the molecules of the invaded area.

A gas at high pressure escapes into a vessel at low pressure, not because of any superior energy of its molecules, but simply because there are more molecules pitted against fewer, and the few are driven back more thoroughly. When an opening is made in the containing boundary of a gas, and outside this opening there is nothing, or very little, that is to say there is a good vacuum, all the molecules at the time moving towards and near to the opening escape, because there is nothing to reflect them. These ceasing in turn to bound back against their fellows, the latter also escape as soon as they can work their way towards the opening. To a very great extent, therefore, steam or gas, when moving along a pipe into a vacuous space, consists of a stream of straight-moving molecules. There is a movement of the molecules transversely to the line of flow, but this gradually diminishes along the length of a pipe, and ultimately attains a minimum. If a turbine bucket were placed so that steam escaped upon it from a nozzle like a fire hose nozzle, the molecules of the steam would have a large amount of transverse movement left in them. The jet would burst laterally as it escaped from the nozzle exactly as a jet of water is burst by the expansive action of any contained air. Therefore it is that in the De Laval turbine, before the steam is allowed to reach the wheel, it is passed through an expanding nozzle until the transverse molecular movement is reduced to such an amount as not to be able to overcome the molecular movement of the fluid into which the steam flows. The steam jet is then said to be at atmospheric pressure, and its velocity is a maximum. It may sometimes be heard said that the velocity of a steam jet is derived wholly from the pressure of steam in the boiler behind it. According to the kinetic theory this is bad reasoning. The velocity of flow of steam into a vacuum is the velocity of each individual molecule. If this velocity is 2,800 ft. per second, then the molecules in their short free paths when confined also move at that velocity.

Clausius calculated the mean molecular velocity of the molecules of air and other gases at 0° C. as follows:—

Air, 485 metres per second; oxygen, 461; nitrogen, 492; hydrogen, 1,844—the velocity varying inversely as the square root of the specific gravity, and increasing proportionately with the square root of the absolute temperature.

A consideration of the kinetic theory may perhaps help to explain why a turbine is much more effective when exhausting to a vacuum than when run non-condensing; but it is less easy to gain from the theory any explanation of why a multiple ring turbine of the Parsons type gains anything by virtue of this multiple nature further than so far as the velocity of the molecules in excess of the velocity at exhaust temperature is absorbed by the earlier rings of blades.

Apparently, the velocity of steam at 100° C. should be about 2,360 ft. per second when flowing into a vacuum. The final temperature of a good vacuum is, however, only about 35° C., or 311° absolute, so that the molecular velocity of steam expanded down to condenser temperature will be about 2,150 ft. per second. Now the escaping molecules must travel at this velocity. They start with a potential velocity of 2,360 ft.; they lose 210 ft. velocity and the maximum ideal efficiency is 210 ÷ 2,360, or nearly 9 per cent.

No power we possess can take out of the molecules their intrinsic movement. No juggling with blade curvature will help us one iota. If it would do so in the same way that it will in the case of water, the steam turbine might have an efficiency of 70 to 80 per cent. The residual molecular velocity is the equivalent of the final temperature of the thermo-dynamic equation $\frac{T_1 - T_2}{T_1}$. Only a fraction of the kinetic energy of the steam can be taken out of it. This fraction may be about 200 ft. per second, half which would appear to be the velocity necessary for a turbine of one ring of moving blades. In steam at 100° C., or 373° absolute, the velocity being 2,360 ft. per second, that of steam at 200 lb. absolute, or, say, about 473° absolute, will be nearly 2,660 ft. per second, and the efficiency should then be $\frac{2\,660 - 2{,}150}{2{,}660}$, or 19 per cent., the velocity reduction being 510 ft.

Thus, after all, the kinetic theory of gases enables one to calculate the efficiency of a turbine on purely mechanical lines with merely elementary mathematics. It helps to an understanding of the thermo-dynamic equation in a way that will appeal to minds more at home in mechanics than in physics. In short, the mechanism of the steam turbine cannot take out of the steam its intrinsic molecular velocity. If the blade velocity were such as to leave no whirling movement in the escaping fluid, the tangential component in a water turbine would represent the loss—*i.e.*, the reduction of efficiency below 100 per cent.—but in steam this tangential component would be found to be the molecular velocity proper to the final temperature.

B.

THE GERMAN ELECTRICAL ENGINEERING INDUSTRY.

The Position of the Glow Lamp Syndicate.

The year 1904 terminated favourably for the German electrical engineering industry in general, most branches having been satisfactorily employed during the twelve months. Reports are in circulation of a further combination which would be composed of the two principal groups, but for the present, at all events, it would seem that there is no intention to form a trust, although the amalgamation of these groups would practically bring one into existence. For the moment the groups, while competing with one another in the open market, are co-operating in special cases, and from mutual action in this respect it is easy to understand that, provided the personal element could be eliminated, the fusion of the A E G and the Siemens-Schuckert Works Co. would not be indefinitely delayed. Pending any future developments, it may be noted that the Mix and Genest Telephone and Telegraph Works Co. proposes to increase its share capital from £180,000 to £250,000 for extensions of works, and increasing the working capital, while an issue of £75,000 has been made at a high premium by the Bergmann Electricity Works Co., of Berlin, thus advancing the capital to £500,000.

The Vienna law courts have just given a decision in the action brought by the incandescent electric lamp firm of Watt, of Vienna, in order to secure a declaration that the International Glow Lamp Syndicate, which is a company registered in Berlin, is invalid, on the ground, as was alleged, of the concealment of agreements made between two of the constituents of the syndicate. The action has been dismissed, the courts holding that German law applied to the syndicate, and that, moreover, the plaintiff firm must have known that the Siemens & Halske Co., at the time of the constitution of the syndicate, was not in a position to manufacture the number (6,500,000) of lamps allotted to it per annum. Apparently this judgement settles the litigation, because the unsuccessful firm will scarcely try and raise the question again—in the German courts. In the meantime the problem of the competition of outside firms, notably that of the Bergmann Co., is beginning to excite a little concern among the members of the glow lamp syndicate as the existence of the latter would be endangered in the event of non-syndicated lamps being placed upon the market on a large scale.

The report for 1903-4 of the Siemens & Halske Co. states that the orders booked in the first half of the year exceeded those in the corresponding period of the previous year by 20 per cent, while the orders received in the second half showed a further advance of 17 per cent. over the first six months. During the year the manufacturing departments were fully employed, and the number of workmen was increased and extensions of the premises were rendered necessary. As in the case of most other large companies, the profit and loss account cites in one total the profits obtained from all sources, namely, £370,500 as compared with £350,934 in 1902-3. After writing off £53,431 for depreciation, as against £72,432 in the preceding year, and, making other allocations, the accounts show net profits of £276,870 as compared with £221,696 in the previous year. The available surplus, as mentioned on a former occasion, permits of the payment of a dividend at the rate of 7 per cent., as against 5 per cent. in 1902-3. As far as the current year is concerned, the report mentions that the orders have been maintained on the level attained at the end of 1903-4. To this report is appended a report by the Siemens-Schuckert Works Co. This states that the fusion of the two original houses has advantageously affected the degree of employment. During the year machines, motors and transformers, of a total of 384,422 KW. were ordered from the amalgamated company and were mainly constructed at the Nuremberg works. The constant increase in activity at the Charlottenburg works would necessitate an extension of the shops by the erection of a new building on the Nonnendamm, while enlargements of the cable factory have already been proceeded with. The business in electric tramways left much to be desired, but the prospects of the introduction of electric traction on main and suburban railways indicated an improvement. The report further remarks that prices were mostly not satisfactory, and severe competition was experienced in nearly all departments. The balance sheet, which shows no profit and loss account, includes the profits for the past year among the creditors as amounting to £532,800 as compared with £364,300. It is, therefore, impossible to ascertain either the exact amount of the profits earned by the amalgamated company or the proportion allocated to the two original companies which also refrain from giving the information in their respective profit and loss accounts.

The shareholders in the Schuckert Electricity Co., at the recent general meeting held at Nuremberg, approved the report and accounts for the year 1903-4. It was stated on behalf of the directors that the company's circumstances had perceptibly improved during

the year, and that the business results of the Siemens-Schucker Works Co., to which the Nuremberg company transferred its entire manufacturing departments some time ago, had fulfilled the expectations which could be raised in regard to the first year's working. On the other hand, all the foreign undertakings of the Schuckert Co. had not exhibited the desired improvement, although certain of them showed satisfactory progress. In reply to questions as to the amount of the manufacturing profit received by the company from the Siemens-Schuckert Works Co., it was intimated that the figures could not be given, and that the matter was one of discretion between the two original companies. It was, however, hinted that the directors would make efforts with a view to giving information on the subject to the shareholders at the end of the current financial year. The accounts submitted to the meeting showed gross profits of £174,758, given in one sum as derived from investments, undertakings and securities. Administrative expenses absorb £14,328; interest on bonds, £65,817; other interest and bank charges and commissions, £27,098; taxes, £2,328, and depreciation, £1,814. These make a total of £111,385, thus leaving net profits amounting to £63,373. The report states that this sum would have allowed of the payment of a dividend, but it has been considered preferable, after placing £3,168 to the reserve fund, to carry the balance forward. The share capital of the company amounts to £2,100,000, and the bond issue to £1,535,000. The report gives particulars of various changes in investments, and cites the Valparaiso electric tramway undertaking as a new participation, while information is also set forth in regard to the position of various undertakings in which the company is interested.

The Helios Electricity Co., of Cologne, which underwent a scheme of reorganisation two or three years ago, has produced a further surprise among the shareholders, inasmuch as the directors' report for 1903-4 shows a loss of more than one-half of the share capital. The loss on manufacturing operations amounts to £44,198, but the critical situation of certain of the subsidiary companies has rendered it necessary to place £220,000 to a reserve fund, and this, the directors state, makes the deficit reach the total sum of £264,198. As a result of an investigation of the position of affairs by a committee, it is proposed to dispose of the works, and to enter into fresh arrangements with the bondholders for a reduction in the rate of interest, and the postponement of the period for the redemption of the bonds, and to adopt other financial measures which would leave the company merely concerned with undertakings as an investor. It is understood that the Allgemeine Electricity Co. and the Siemens-Schuckert Works Co. have made a joint offer of £105,000 for the Cologne-Ehrenfeld works, while the machinery and plant would be purchased by agreement. As under this arrangement the production of electrical plant would be discontinued, a local scheme is reported to be on foot for the formation of a new company to take over the works and continue the business.

The Wagon and Machine Works (Busch) Co., of Hamburg, which underwent reconstruction in 1901, is now being reorganised in such a manner that the directors expect the undertaking to be placed permanently on a sound basis. The year 1903-4 has closed with a debit balance of £42,500, of which the sum of £33,000 represents a loss incurred in an English company. The Hamburg Co., which is largely engaged in the construction of electric tramcars, states that this branch has only slightly increased in Germany, although favourable export orders, and particularly for South America, have been received, and prices have become more satisfactory. It has now been decided to reduce the share capital, and to issue preference shares and raise a 4½ per cent. loan of £50,000. In this way it is hoped that the business will be brought once more into a remunerative condition.

Among other German companies may be mentioned the Insulated Wire Works (late C. T. Vogel) Co., of Berlin, which has declared a dividend at the rate of 8 per cent. for 1903-4, as compared with 6 per cent. in the previous year, and the E. H. Geist Electricity Co., of Cologne, 6 per cent. as against 3 per cent. On the other hand, the Carlsruhe Electrical Industry Co. has incurred a loss of £11,560, as contrasted with a deficiency of £7,580 in 1902-3, while the Saxon Electricity Works (late Poeschmann) Co., of Dresden, has decided to go into liquidation.

CENTRAL STATION POWER SUPPLY IN GREAT BRITAIN.

Mr. Addenbrooke's review of Power Station prospects put forward in the *Engineering Magazine* estimates an immediate prospective investment of £100,000,000, a figure that may be doubled by railway electrification. At £50 per horse-power, the above estimate would provide for some 2 million horse-power, a figure which, it is estimated, might be supplied by the gas from blast furnaces that is now going to waste, which, as proposed by Mr. Thwaite, should be employed for power generation. Legislation in electric power schemes has now extended over seven years, and the various principles involved have been subjected to the criticism of technical and commercial men.

The general technical criticism resolves itself into the question as to whether power can be generated and sold at a profit by large undertakings working on a comparatively good load factor to power users generally at less than they can for themselves produce it at. Undoubtedly there are thousands of small, some moderate, and a few large users of power whose use factor is very low; but the large manufacturer, such as the cotton spinner, has a load factor not far from 100 per cent., and he uses about 1,000 H.P. all day, so that if cost of energy alone is considered, at present he is better off than were he a purchaser of power.

Suppose a user of 1,000 I.H.P. pays £10,000 for his power plant, and that it costs him 2 lb. of coal per H.P.-hour, the annual coal will be 2,500 tons. Call the cost £1,250, which is higher than the facts in many instances. Then, with £500 for interest, an equal sum for depreciation, £250 for wages, £100 for oil, &c., the total is £2,600. Let us call it £3,000 to include contingencies. The 1,000 I.H.P. is equivalent to 746 units. We will deduct a fifth for the engine and rope gear, and this leaves 600 units per hour, or 1,680,000 per annum of 2,800 hours, representing, at 1d., £7,000, or considerably over double the cost of steam if the unit be sold for 1d.; the mill-owner must still find fuel to warm his mill, and will, therefore, be compelled to pay for some coal and for some labour, and he must employ an engineer at wages as high as before. Thus, even at 0·5d. per unit, the cost could scarcely be less than £4,000, and in this there is no provision for interest and depreciation of motors. It is, therefore, not with large factories that the power stations must expect to deal for some time to come. But there should be a considerable small custom, and possibly some development of electro-metallurgy, and, let it be hoped, a very large demand for power to work our canals should these be again placed on a sound and free basis. Indeed, canal haulage offers one of the finest prospects for the power scheme, for the canal boat alone stands in the same relation to distributed electric power as does the motor-'bus to the electric tramway.

A brief review is offered by the author of each power scheme so far materialised. In South Wales, the three-core 11,000-volt cables are satisfactorily feeding points 10 and 11 miles distant, many of the South Wales collieries are negotiating for power, and over 11,000 H.P. has actually been ordered, and one contract for 2,200 H.P. closed for one colliery.

The nature of the loads met with in South Wales, and the inferior class of engines used there, should help to make an electric supply commercially successful. It will be of interest to see what the Lancashire and Yorkshire power schemes secure in the way of loads. Until a year or more has elapsed, the prospects of business can never be accurately foretold. Much of the business cannot come until present appliances are worn out or new works are built, and so on, but there will always be a succession of customers whose demands were not even suspected, and when present schemes have begun to show glimpses of what other schemes may expect, it may prove more easy to set other measures on foot. We hope that the railways, when electrified, will be good customers of the power stations, and will not insist on manufacturing for themselves, unless over areas outside electrical power areas.

The success or failure of the large gas power station in Johannesburg will not, perhaps, either prove or disprove the case for gas power, but it is much to be hoped that success will attend the project, for it would be a very powerful fillip to the use of large gas engines, and it would incidentally go far towards helping forward the use of the gas wasted by the iron smelters and coke burners, and would thus utilise the large tonnage of our diminishing coal supplies which is going so deplorably to waste.

INSTITUTION OF ELECTRICAL ENGINEERS.

SOME POINTS ON THE SELECTION OF ELECTRIC CABLES.

By Ll. B. Atkinson, M.I.E.E., and C. J. Beaver, A.M.I.E.E.

(*Abstract of Paper read at Manchester, January 31st, 1905.*)

(*Concluded from page 373.*)

As the final insulating property of fibrous dielectrics depends on the exclusion of moisture, the lead envelope is very important. Standard thicknesses have been embodied in tables drawn up by a committee of the Cable Makers' Association.

These thicknesses must be taken as minimum thicknesses; in certain conditions of soil and surroundings it is advisable to increase them.

The lead is put on such cables in a plastic state by hydraulic pressure. This is an operation requiring such care to avoid minute cracks or damage from particles of oxide being forced in with the lead, that there are engineers who still advocate the older system of drawing the cable into a lead pipe which has already been tested by water pressure, or of putting on double sheaths of lead. Messrs. W. T. Glover & Co., Ltd., have, however, met the question by the use of hydraulic pressure up to 100 lb. per sq. in. applied externally after the cable is finished. Such pressure invariably detects a fault if such exist in the lead. The ordinary tank test is practically useless, it may take many months or even years for water to enter the very fine seams which such faults occasion, but eventually it will do so. No doubt in the past this has been the reason for many unexplained failures, while many more have been due to corrosion. The chief causes of corrosion of lead coverings under working conditions may be summarised as follows:—

(1) Impurities in lead, causing local galvanic action.
(2) Galvanic action between lead and adjacent metal.
(3) Corrosion by chemical action.
(4) Electrolysis.

Causes of corrosion due to (1) are very rare.
(2) Is also seldom met with.

(3) Is fairly common, and may occur in certain soils or where organic acids are produced as the result of the decomposition of wood or vegetable matter, or where cables are laid through made up ground, especially where ashes or clinkers are abundant. Most pit waters have an appreciably corrosive effect on lead, some being extremely severe in their action.

(4) This is by far the most serious form of lead corrosion. Taking the word electrolysis in its broad sense, it is also the most common form, though this is not usually appreciated. It may occur under conducive conditions even in isolated house wiring installations where lead-covered wires are used, neither tramway nor heavy lighting cables being near.

The character of the corrosion may vary from small holes which gradually penetrate the lead covering, converting the lead into various oxides of lead, and only make themselves apparent when the rubber dielectric becomes oxidised to a sufficient extent to breakdown, or the paper dielectric sufficiently exposed to absorb moisture and fail (which may take many months) to very extensive action and a high degree of oxidation (where there is a free and continuous supply of the electrolytic medium and a small difference of potential) or a limited amount of general corrosion, followed soon by fusion (where the supply of the electrolytic medium is small or not continuous, and the difference of potential is comparatively high).

The first described result is most common in small and medium size lead-covered cables laid or fixed in wood casing, or in conduits which are fairly dry or which do not actually have water running through them.

The lead covering in such cases is only in intimate contact with the wood casing or conduit intermittently, and the corrosion naturally takes place chiefly at such places, which are the paths of least resistance. If such corroded points are carefully examined at various stages of the corrosion it will usually be found that a cone-shaped hole is eaten away and that the lead is converted into oxides, the various colours characterising the degrees of oxidation being clearly distinguishable, the extreme outer layer becoming converted into the white carbonate by exposure to the moist atmosphere. In rubber cables the rubber usually fails quickly when the lead is finally penetrated, owing to oxidation of the rubber; but in the case of paper cables, if undisturbed, the oxides into which the lead is converted will keep out atmospheric moisture for, possibly, years and the effect of the liberated oxygen on the paper (if made of pure Manilla only and well impregnated) will be negligible.

The second described action (where there is a continual supply of the electrolyte and small P.D.) chiefly occurs in conduits where water is continually trickling through; and in such cases the degree of oxidation is high and fairly uniform throughout the thickness and along the surface of the lead. The corrosion is practically confined to the bottom of the cable. The P.D. being low, and the surface exposed to the electrolytic medium being large, the current density will be very small, and therefore the final failure of the cable may take a year or two. The slowness of the action and the fact that the surface affected is more or less continuously covered with the electrolytic medium, accounts for the high degree of oxidation and the comparative absence of carbonate on the surface in such cases.

The third case where a limited amount of corrosion is followed by fusion of the lead, generally occurs on large networks carrying heavy currents or on electric tramway and railway systems, where bonds may be fused by heavy leakage currents resulting from a short-circuit, whereby the lead coverings of cables may be raised to a P.D. of, say, 10 to 20 volts. There may, under such circumstances, of course, be immediate breakdowns of other lead-covered cables, but in some cases the whole of the resultant damage may not be at once ascertained, and the consequent leakage currents may go on for some time causing corrosion wherever lead coverings are even only partially exposed (for instance, in the case of cables laid on the solid system imperfectly, or where the ends emerge into manholes, &c.). Supposing in such a case the electrolytic medium to be entirely decomposed and dried up by the passage of a heavy leakage current (obviously at a high current density), sparking from the lead, and fusion of the same, may easily ensue.

It is not proposed here to touch further on the diagnosis of breakdowns due to lead corrosion. Enough has been written to indicate the extreme care necessary to avoid conditions which tend to produce lead faults, and incidentally to indicate that the use of lead-covered cables on large networks carrying heavy currents will probably be limited in the future, or that elaborate and costly precautions will have to be taken. It is obvious that bonding and earthing judiciously and sufficiently is the remedy for electrolytic faults, but in the first class of electrolytic faults, roughly and generally described above, bonding is frequently neglected.

In the second class, it is worthy of note that bonding and earthing, even if in accordance with Board of Trade regulations, is probably not a sufficient protection to prevent lead corrosion under the conditions referred to.

In the third class, it is fairly common for conditions to arise under which bonding and earthing arrangements, designed with a large margin of safety, are unavailing; and where very large currents return by earth paths as the result of breakdowns, it is almost impossible to forecast or predetermine what will happen on various parts of the network.

As a preventive measure against leakages of current from conductor to lead covering at connections in paper cables, where sealing boxes or terminals are difficult to fix, a waterproof non-fibrous sealing tape such as Glover's Guttaroid tape should be used, the tape being lapped over the trim, from thimble to lead covering. Pure rubber or even proofed tape is often used on small cables by contractors, but is of little use under damp conditions, as either will absorb moisture in course of time, apart from the fact that they do not form a homogeneous covering.

Instead of a covering of lead, a waterproof envelope of non-metallic material may be provided. Such cables are made by Messrs W. and T. Glover & Co. under the name of Paper Leadless, and are covered with a compound called Guttaroid, which is of the same class as those described under V.B. cables, but chosen more with a view to its waterproofing than its dielectric qualities. Such a cable has all the advantages in high specific insulation, dielectric strength, and low specific capacity of the lead-covered paper cable, with the further advantage of a reduction of actual capacity due to the absence of a metallic sheath, and is specially suitable for use for tramway or railway feeders, which have developed some difficulties with the return of heavy currents by the lead sheath causing electrolytic trouble and breakdown.

Appendix I.—Glover's Test for Tinned High Conductivity Copper Wire.

Reagents.—Hydrochloric acid of S.G. 1·088 (= 44 per cent. of acid of 1·2 S.G.).

Sodium sulphide solution of S.G. 1·142 (= about 25 grammes per 100 c.c.'s water).

Testing Process.—The samples are cleaned with alcohol or ether, and immersed for one minute in the hydrochloric acid. They are then rinsed in clean water, and immersed in the sodium sulphide solution for 30 seconds, again washed, and examined under a hand lens.

This cycle of operations is repeated until blackening of the wire becomes clearly visible. The number of such cycles required to produce this blackening effect is noted, and taken to represent the measure of efficiency of the tinning.

The tests are performed in duplicate.

The wires are bent into loops before immersion, to avoid testing ends. The loops should not be bent to a smaller radius than 12 to 15 times the diameter of the wire.

As a mechanical test for adhesion of the tinning to the wire, samples may be bent round a rod having a diameter equal to four times the diameter of the wire. Any cracking or parting of the coating will be plainly shown by one immersion, according to the test described above.

No wire should show blackening after the mechanical test on immersion for one minute in the sodium sulphide solution only.

The *average* values obtained from samples taken from any batch of wire should be as shown below:—

Diameter of wires.	Number of immersion at 60° F. Single tinned wire.	Double tinned wire.
From 0076″ to 048″ inclusive ...	6	8
Above ·045″ to ·080″ ,, ...	5	7
,, ·080″ all sizes	4	5½

Appendix II.—Extracts from General Specification for Lighting and Power Cables for Pressures up to 500 Volts.

Dielectric Paper.—(3) The paper to be composed of pure Manilla fibre. It is to be free from all metallic particles, carbon spots or foreign matter, and to show no trace of chlorine, or other residual chemicals on analysis. It must be free from the slightest admixture of straw, wood, or other ligneous fibres. The paper after drying to be impregnated with a high class insulating compound at a temperature not exceeding 250° F., and to be laid spirally upon the conductor in strips to required thickness, in such a manner that the joints are efficiently staggered. The paper strip to be of uniform thickness throughout, not exceeding 006 in., before impregnation. The tensile strength of a standard strip 15 mm. wide, cut longitudinally from the paper before impregnation must not be less than 10 kg., but it should be so highly impregnated that its strength is increased by 15 per cent. after impregnation. The insulating compound should be of such a character that it is solid at the ordinary working temperature, and should have no tendency to drain away from the cable. It should also be capable of allowing the cable to be sharply bent without any sign of cracking in the paper dielectric. The compound must have no deleterious effect on the copper, paper, or lead.

Rubber.—(4) The conductors are to be covered, first, with a layer of pure unvulcanised fine Para rubber, containing not more than 2·25 per cent. of rubber resin, and then with two layers of vulcanising rubber compound to an approved thickness. The vulcanising rubber compounds to consist of the finest hard Para rubber, mixed with sulphur and mineral matter only. No rubber substitute, or organic matter other than rubber is to be used. The proportion of hard fine Para rubber in the vulcanising compound rubber, in the case of the 500-volt cables, is to be not less than 40 per cent. by weight. In the case of wire, or cables having a sectional area of less than ·06 sq. in., the rubber compound is to be applied longitudinally. Larger cables are to be spirally lapped to an approved thickness. The pure and compound rubbers to be vulcanised into a homogeneous mass after taping.

Compound.—(6) To be of the vulcanised bitumen class of compound, containing not more than 20 per cent. of mineral matter, to be of such consistency that it will not become decentralised at such temperatures as ordinarily obtained in practice. It must not become brittle at the freezing point of water. It must be so made that it is not readily oxidisable, and that it will resist the action of weak acids and alkali. It is to be applied to the cable in the form of a solid tube free from pinholes and similar defects, so that the insulation resistance shall show no deterioration after the insulated cable is submitted to hydraulic pressure of 100 lb. per. sq. in. for at least five minutes.

Fire-Resisting Coverings.—(9) The fire-resisting coverings may consist of cotton tapes, jute or cotton lappings, or braidings. The radial thickness of such coverings to be proportionate to the diameter of the cable and the radial thickness of the insulation. The tapes, braids or lappings to be chemically treated prior to their application to the cable, with suitable fire-resisting compound, which shall have no deleterious effect on the fibrous material or the insulation of the cable, and shall be of a permanent character. During the taping, lapping or braiding process, the fire-resisting coverings to be further served with suitable fire-resisting compounds, and finally served over all with special compound of a similar nature, to ensure a firm but flexible finish.

Insulation Tests.—(11) All cables, as specified above, should be tested after 24 hours' immersion in water in the case of vulcanised rubber cables, and after five minutes' hydraulic test in a closed tank at 100 lbs. per sq. in. in the case of the other types, with a battery giving an E.M.F. of not less than 500 volts. The insulation resistance must be taken after one minute's electrification, and such electrification must proceed steadily and uniformly. After the application of 2,500 volts for half an hour, there should be no appreciable difference in the insulation resistance of the cables.

Mechanical Tests.—(12) A 10 ft. length may be taken from any of the cables and bent three times in reverse directions round a drum having a diameter of not more than 12 times the diameter of the cable. The length, when subsequently immersed in water and tested with a gradually increasing voltage, should not break down under a pressure of 5,000 volts.

In the discussion which followed, Mr. Miller said that there was up to the present very little information to be had on the question of cables, and the paper was a valuable addition to the literature of the subject. In the past it had only been thought necessary to specify the insulation, conductivity and breakdown test, but it now seemed that a great deal more ought to be specified; he thought that the best safeguard was to go to a really good firm. The use of lead-covered cable would probably be limited in the future, and it was satisfactory to know that good vulcanised bitumen cable was obtainable. He had found that trouble was met with where cables passed urinals. With regard to electrolysis, he knew of places in Liverpool where lead pipes could not be made to stand, owing to the condition of the soil.

Mr. Pocklington also mentioned the case of a length of cable in the vicinity of a urinal that was entirely ruined, and which had to be relaid. The temperature effect on paper was very much higher than he anticipated.

Mr. Watson thought that cable makers ought to be very rich men, considering the amount of adulteration which had been carried out in the past. He agreed with the authors on the question of lead-covered cable, and thought that it would be used far less in the future. It was a mistake to employ it in large towns, where there were tramways and earth currents; in his opinion, vulcanised bitumen cable should be used, the latter having been in use for about 10 years now, with very satisfactory results.

Mr. Cooper said that he had experienced very little difficulty from electrolysis, and he thought that if the lead was connected to earth throughout the system, very little trouble would be met with. With regard to paper-insulated cable, he had lately cut a length of cable which was laid on a steep grade, and found that the oil was not running down hill.

Mr. Harvey praised vulcanised bitumen cable; he only knew of one case of decentralisation, and that was where the cable was laid over a baker's shop. There would, however, be no trouble with it if laid properly.

Mr. Aitchison suggested that the gas and water mains were far more trouble to electric mains than *vice versâ*. He remarked that the Engineering Standards Committee appeared to have brought up the insulation of cable, and apparently the cable makers were trying to keep it down as much as possible. With regard to earthing and bonding, sometimes trouble arose from this where cables passed under a tramway track. He knew of an undertaking where rubber cable had been laid down for about 10 years, and had given no trouble.

Mr. Taylor referred to the necessity of using insulating compounds of proper consistency. He knew of a case where a cable was wound round a drum 4 ft. in diameter, and, on examination, it was found to be split in several places due to the insulating compound being rather hard.

Mr. Peck asked, if the temperature remained constant, would the insulation resistance also remain constant? As a result of many different tests on insulation resistance, he found that if the temperature was low the insulation resistance was high, and if the temperature was high the insulation resistance came down very rapidly, also if the temperature remained constant, the insulation gradually increased. He remarked that in testing electrical apparatus, a power test is much more feared at a high temperature than at a low one.

Mr. Beaver, in replying, agreed that earthing should be carried out very judiciously, and that every case should be considered on its own merits. Various speakers had testified that, with V.B. cables, trouble had been experienced through decentralisation. It must be borne in mind that chemical action is generally electrolytic action. He could not say, from experience, that the insulation resistance varied with the temperature; he took it that the speaker referred more particularly to dynamos and motors than cables. He added that it would be well to remember that the results of the tests given in the paper were to be regarded as ageing tests, and were rather exaggerated; it was demonstrated, however, that the action shown by the experiments would, sooner or later, occur.

APPLICATION OF ELECTRICITY TO MINES.

By A. C. Anderson, Student.

(*Abstract of Paper read at Birmingham, February 15th*, 1905.)

The author, in an introduction, points out that compressed air, electricity's only formidable rival, is not so efficient for driving as the latter, although it frequently plays a subsidiary part.

On the choice of a system, three-phase, though costly to produce owing to the relatively poor power factor, is the cheapest to install, given material and workmanship of equal quality; it also appears to be freest from breakdown, and sparking can be eliminated. Polyphase motors, however, have disadvantages for coal-cutting work, owing to the great fluctuations of load. Speed variation is practically essential in most of the departments of mining work, and can be accomplished very economically with direct current machinery. For a large scheme an alternating system is preferable, but direct current plant, working at 500 volts, in the case of comparatively small plants.

In discussing voltage, the author suggests that 650 volts at the face (the limit up to 75 H.P. for motors and transformers allowed by the new rules) is rather low. Generating plant, distribution and motors are briefly referred to, prominence being given to the experiments of Mr. Garforth and Mr. Mountain on the chances of explosion with enclosed motors working in gaseous mixtures.

The author gives particulars of the work of one of Messrs. E. Scott & Mountain's disk coal cutters at Smithywood colliery, from which it appears that during a 270 minutes' run some 105 yd. were cut, the average amperes being 37 and voltage 470.

With regard to electrical drilling in rock, some interesting results are quoted from British Columbia; an 86 in. hole, 2 in. diameter, was drilled in 19 minutes, with an expenditure of 940 watt-hours, or at the rate of ·655d. per ft. This compares with a minimum of 5d. per ft. when drilling by compressed air or steam. Favourable results are also quoted for electrical ventilating, and the author concludes with a critical summary of the new rules for electrical working in collieries.

In the discussion which followed, Mr. Jackson said that where slip-ring motors were used, he recommended the use of more than one brush per ring, as this reduced the liability of sparking. A frequency of 50 cycles per second was usually found most convenient.

Prof. Redmayne said that he favoured electricity as a motive power in mines; steam and compressed air were, however, still largely used. Compressed air would continue to be a formidable competitor to electricity so long as there was any liability to sparking troubles with electric systems. Too much stress could not be laid on this question. In many cases sparking might result in an explosion. The author had quoted 30 per cent. as an efficiency figure in connection with compressed air systems. Very old plants might show this figure, but modern systems, employing isothermal compression combined with re-heating, had frequently an overall efficiency as high as 70 per cent. But thermal efficiency was not such an important consideration as simplicity of apparatus. It was a moot point whether electricity or compressed air was the better system of power to use. In the majority of instances that had come under his notice, the quality of material and workmanship put into electric installations in mines and collieries was extremely good. With respect to drilling, it was a fact that electricity had absolutely failed to compete with compressed air as a motive power. There were several electric drills, more especially of the rotary type, that would do good work, but they were not suitable for mines. They were much more complicated than pneumatic drills, and more costly in upkeep. He hoped that a suitable electric drill would be designed. The figures quoted by the author to show the cost of coal cutting could not be taken as reliable, as the hardness of coal varied considerably even in the same pit.

Mr. Reavell advocated air compressors, used in conjunction with electric generators at pit head and electric distribution to different parts of the mine. This system would reduce first cost, and result in a greater economy of working than any other. The electric power might be used for all suitable work, such as pumping, but pneumatic machinery was most suitable for coal-cutting, drilling, &c., and the compressed air for these could be supplied by an electrically-driven air compressor through short lengths of pipe. Coal-cutters frequently jambed. With a pneumatic tool, it was a simple matter to cut off the air supply, withdraw the cutter, and make a fresh start; but in the case of an electrically-driven machine, it meant the replacing of a fuse, and a consequent delay. Another advantage resulting from the use of compressed air was its storage capacity. With a system entirely depending upon electricity, the generating plant had to have a capacity capable of dealing with the whole of the equipment. He condemned compression at the pit head, as it frequently resulted in the loss of 50 per cent. of the power generated.

Mr. Gott thought that the argument of economy in fuel consumption might easily be overdone. In most mines there was a large amount of fuel unsuitable for sale, which had to be disposed of, and which the mining engineer frequently utilised himself. Wholesale waste in pipes was consequently a minor consideration compared with convenience and economy of coal cutting. Many engineers also considered that the loss due to friction in the shaft pipes, was compensated for by the head. Commutator sparking was largely due to vibration; this should be reduced as much as possible by careful design. One of the troubles of electric distribution was the fact that in the shaft cables the core was liable to slip down the insulation. This necessitated a special form of suspension. A reference had been made to the running up of motors with

generators, he wondered this was not more frequently done. A point the author had omitted was the necessity of lightning arresters, where overhead wires were used for lighting and power transmission at the pit head. He instanced a case in which the omission of this precaution had necessitated the replacing of the shaft cables.

Mr. M. B. Wild regarded the choice of system as not settled by the question as to which was the cheapest to install in the first instance, but by considerations as to which system could pull out the greatest amount of coal with ease and safety. He found that with D.C. plants, considerably more power in motors could be put below ground than with A.C. plants, for a given power of generator on surface. Again, with D.C there was no trouble due to motors falling out of step and causing stoppages, when the generator was momentarily overloaded. D.C. motors, properly designed for secondary haulage, and a suitable reversing controller with sufficient resistances, constituted an electric haulage gear as flexible as a steam or compressed-air hauling engine. There should be no necessity to use a friction clutch, which many electrical engineers had to do, to get over defective starting gear, such as liquid switches and badly designed controllers. Another objection to liquid starting switches was that the liquid very soon evaporated, thus necessitating constant attention. Further, with D.C., supposing there was a stoppage for some time on a particular road, the speed could be increased considerably, so as to bring out the coal that had accumulated. A standard speed for single or double drum gears was 5 miles per hour, but they worked without any trouble at speeds varying from 2 to 8 miles per hour. With an A.C. system the speed of the motors could not be varied. For pumping and very large haulage, such as endless rope, main and tail with long runs, no doubt A.C. would be the better system. From personal experience, he had every confidence in saying that, in most collieries the haulage could be done by electricity, or, in very firey mines, with compressed air from an electrically driven compressor placed as near as possible to the gears, consistent with safety.

Mr. H. M. Hobart, in a written communication, expressed the opinion that both direct and polyphase systems will find wide fields of usefulness in mining work. In those cases where the use of polyphase currents is most suitable, it is of paramount importance to employ a low periodicity, for it is the power applications which are of chief importance in mining, and any questions relating to the quality of the lighting, are of secondary importance. Moreover, it is a fallacy to regard the question of lighting at low periodicities as offering grave difficulties. The lower the periodicity, the lower should be the voltage chosen for the incandescent lighting circuits, and the higher should be the candle power per single lamp; for by these means the carbon filament employed will be of sufficiently large section to be able to store the heat and obviate material reduction of temperature between the peaks of current of successive cycles. It will necessarily follow that the luminosity will then be more constant. But the chief desideratum, that of excellence in the design and performance of the motors, is enormously promoted by the use of low frequency. This will lead to higher power factors, lower magnetising current, even with larger air gap, greater overload capacity, and also cheaper motors, since for a given output the diameters will be smaller and the lengths greater. Capacity effects in the cables will also be decreased. The squirrel-cage type should be freely used, even in motors of large capacity.

Mr. Anderson, in his reply, admitted that steam was still largely used, but there was no doubt that the losses in the distribution system were of a most serious character. "Economy of coal cutting" was impossible with a "wholesale waste in pipes." Undoubtedly, mining engineers as a body regarded fuel economy as of considerable importance. The electrical equivalent of the compressed air storage system was the battery, a most convenient factor. It was a very difficult matter to obtain reliable comparative figures of coal-cutting performances, as the conditions of working were so various. The replacement of fuses in connection with coal-cutters driven by polyphase motors was of rare occurrence. Liquid rheostats were very good as starters; for variable speed work the ordinary type of regulator would be used. The advocacy (Mr. Hobart's) of a low frequency was very interesting, but the low voltage necessary for successful lighting would hardly conduce to the best economy. The system of starting motors by running up with the generator, added considerably to the capital outlay, as separate circuits were necessary. He agreed with the necessity of employing machinery of as simple a nature as possible.

TRAMWAYS PERMANENT WAY CONSTRUCTION AND MAINTENANCE.

By James Lord, A.M.I.C.E.

(Abstract of Paper read at Leeds, February 16th, 1905.)

This paper is based on the author's experience, in constructing and repairing municipal tramways at Bolton, Accrington, Blackburn and Halifax.

After referring to the several methods of laying track, he gives it as his opinion that it is better to lay the metals first and the concrete afterwards—a practice which he always follows. The metals are placed on wooden blocks packed up with wedges to the exact level, at intervals of about 9 ft. apart; the line is then crowed, afterwards the concrete is packed under the metals and the remainder of the track, to the level of the bottom flange of the rail. After two days the wooden blocks are taken out, and the holes filled in with concrete, and the following day the whole of the crevices under the metals are run in with a mixture of sand and cement (1 to 1). His objection to packing is that men do not pack equally, and this leaves the rail slack in places, which, with the vibration of the cars, causes the setts to lift.

The author much prefers 45-ft. rail lengths, as they are more readily handled, especially in narrow and steep roads; secondly, there is not the same danger, as in longer rails, of acquiring a permanent set or hog-back by sagging. In the 60-ft. rails, there are less joints to contend with, which also means less electrical resistance, but to counteract the cost of the joints, the 45-ft. rail only requires one intermediate anchor, whereas the 60-ft. rail ought to have two to each rail, or the rail will not sit perfectly solid.

The author gives specifications of weight, analysis and suitable tests for rails. He has used rails 105 lb. to the yard on sharp curves with 1¼ in. groove, and is of opinion that the gauge on curves should be slightly less, varied according to the sharpness of the curve. In his experience of manganese and crucible cast-steel points and crossings, the former has a longer life. He uses 8 ft. 6 in. points with 5 ft. tongues and 4 ft. crossings, except on very sharp curves, but advises that the length of each tongue should be 6 in. longer than the wheel base of the car, so that the trailing wheels are on the tongue before the leaders leave.

In 1900 the author laid about half a mile of track on 10 in. × 4 in. creosoted red wood longitudinal sleepers; these sleepers were embedded in concrete and the metals screwed down with coach screws at intervals of 4 ft. 6 in., but the difficulty was to keep the setts level with the rails, owing to the slight vibration which took place. If it were not necessary to keep the surface of the road in good condition for vehicular traffic, the writer would much prefer the lines to be laid on timber.

The life of local (Halifax) setts in busy thoroughfares was certainly not more than three or four years, those next to the rail wearing down quite 3 in. in that time.

The author thinks it essential that every tramway engineer should have an emery rail grinder. His was built by Messrs. Ames Crosta and Co., Nottingham, and is fitted up with an electric motor, so that it can travel and work from the overhead wire. It is also provided with a 12-H.P. petrol motor, for independent working and with a complete set of drilling apparatus for drilling longitudinally and vertically.

Some tests made of the electrical resistance of thermit welds and otherwise gave the following results:—

		Ohms.
1.	Taking a solid rail 8 ft. long as a standard resistance ...	·000067
2.	With thermit welded joint, without bonds, same length	·000072
3.	Do. with one do.	·000067
4.	Fishplates, sole-plate and two bonds, newly constructed	·000078
5.	Do. after 2 years ...	·000095

The welded joint has a considerable mechanical strength, and in a number of tests the rail has broken and not the joint.

The lay out of the curves has an important bearing on the maintenance account; on many curves which are 35 ft. radius, a new rail check is required at intervals of about nine months.

PHYSICAL SOCIETY.

At the annual general meeting held February 10th, 1905, Dr. R. T. Glazebrook, F.R.S., President, in the chair, the report of the Council was read by the secretary. The number of Fellows now on the roll is 425, an increase of 7 over the number last year.

During the year the President signed, on behalf of the Council, a petition in support of a Bill for the metric system.

The report of the treasurer for the year 1904 was read by the secretary. Additional expenditure was incurred last year, amounting to £115, in bringing *Science Abstracts* up to date; but the income from subscriptions has increased, so that, on the whole, the position of the Society remains almost unchanged.

The following officers and Council were elected for the ensuing year:—

President.—Prof. J. H. Poynting, D.Sc., F.R.S.

Vice-Presidents.—Those who have filled the office of President together with C. Chree, D.Sc., F.R.S; H. M. Elder, M.A.; Prof. J. A. Fleming, M.A., D.Sc., F.R.S.; J. Swinburne.

Secretaries.—W. Watson, D.Sc., F.R.S., and W. R. Cooper, M.A.

Foreign Secretary.—Prof. S. P. Thompson, D.Sc., F.R.S.

Treasurer.—Prof. H. L. Callendar, M.A., F.R.S.

Librarian.—W. Watson, D.Sc., F.R.S.

Other members of Council.—T. H. Blakesley, M.A.; C. V. Boys, F.R.S.; A. Campbell, B.A.; Prof. W. Cassie, M.A.; W. B. Croft, M.A.; W. Duddell; W. A. Price, M.A.; S. Skinner, M.A.; Prof. F. T. Trouton, Sc.D., F.R.S.; Prof. S. A. F. White, M.A.

Prof. Poynting then took the chair, and delivered an address on "Radiation Pressure."

At the meeting held February 24th, Prof. J. H. Poynting, F.R.S., President, in the chair, a paper "On the Curvature Method of teaching Geometrical Optics" was read by Dr. C. V. Drysdale.

Mr. R. J. Sowter exhibited and described "Dr. Meisling's Colour-Patch Apparatus." The apparatus is specially adapted for testing colour-blindness.

Mr. J. Schofield read a paper on "A Method of illustrating the Laws of the simple Pendulum."

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

3,479. "Electrical communications with trains whilst the same are in motion." F. Mcrgan. February 20th.

3,510. "Improvements in and connected with devices for preventing the over-charging of electric cables." Land und Seekabelwerke Akt. Ges. (Date applied for under Patents Act, 1901, April 1st, 1904, being date of application in Germany.) February 20th. (Complete.)

3,511. "Improvements in devices for preventing the over-charging of electric cables." Land und Seekabelwerke Akt. Ges. (Date applied for under Patents Act, 1901, April 1st, 1904, being date of application in Germany.) February 20th. (Complete.)

3,525. "Improvements in apparatus for producing electric reactions in gases by aid of electric arcs." K. Birkeland. (Date applied for under Patents Act, 1901, February 20th, 1904, being date of application in Norway.) February 20th. (Complete.)

3,538. "Sectional system for third or electrified rail on electric railways." J. Reed. February 21st.

3,553. "Improvements in fuse heads for electric blasting." F. Render. February 21st. (Complete.)

3,562. "Improvement in electric arc lamps." A. Eckstein and A. E. Angold. February 21st.

3,567. "Improvements in fog and ordinary signalling for steam and electric railways and the like." J. J. Munro and T. Common. February 21st.

3,568. "Trolley change guide for electric tramway cars." J. Stewart. February 21st.

3,573. "Improvements in electrical means for starting prime-movers for electric generators and controlling the current." A. W. Sclater. February 21st.

3,591. "System of sparking plug for internal combustion engines." L. Boulez. (Date applied for under Patents Act, 1901, February 22nd, 1904, being date of application in France.) February 21st. (Complete.)

3,594. "Improvements in and relating to the transmission of electrical energy through space for the purpose of wireless telegraphy and the like." A. Artom. February 21st. (Complete.)

3,604. "Improvements in and relating to prepayment attachments for electricity meters." R. J. J. Swan. February 21st.

3,614. "Improvements in trolley heads employed in electrical traction." C. E. France. February 21st.

3,616. "Improvements in fuses for electric current circuits." E. F. Moy and P. H. Bastie. February 21st.

3,685. "Improvements in and relating to ships' telegraphs and like signalling devices." C. Coleatti. February 22nd. (Complete.)

3,688. "Improvements in or relating to electric warp-stop motions for looms for weaving warping machines and the like." C. H. Whittington. (F. M. Armstrong, United States.) February 22nd. (Complete.)

3,719. "Improvements in and connected with X-rays and high-frequency apparatus." D. B. Selkirk, W. W. Scott and W. Cousin. February 23rd.

3,726. "Improvements in or connected with electric wires." A. E. Patrick. February 23rd.

3,759. "An electrical railway signal." V. C. Badois. February 23rd.

3,762. "Improvements in and relating to electrical circuit breaker mechanism." W. E. Barton. February 23rd.

3,784. "Improvements in or relating to wireless telegraph detectors, and telephone electrophone and like receivers." H. A. Cutmore. February 23rd.

3,795. "Improvements in the electric lighting of railway and tramway carriages." J. Stone & Co., Ltd., and J. R. Quain. February 23rd.

3,796. "Improvements in accumulator batteries." J. Stone & Co. Ltd., and J. R. Quain. February 23rd.

3,814. "Improvements in the structure of accumulator cells." H. Leitner. February 23rd.

3,815. "Improvements in electric potential indicators." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) February 23rd.

3,816. "Improvements in and relating to gearing especially applicable to power operated electric switches." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) February 23rd.

3,829. "Improvements in and relating to electrical ignition devices for internal combustion engines." J. A. Cole. February 23rd.

3,830. "Improvements in and relating to electrical ignition devices for internal combustion engines." J. A. Cole. February 23rd.

3,855. "Improvements connected with the starting, reversing, accelerating and stopping of electric motors." E. S. W. Moore and W. B. Bennitt. February 24th.

3,857. "Controlling devices for electric motors." W. Fairweather. (Diehl Manufacturing Co., United States.) February 24th.

3,877. "An improved electric incandescence reading lamp." O. Imray. (J. Pintsch, Germany.) February 24th.

3,885. "Improvements in electric trolley harps." J. Hensley. (Date applied for under Patents Act, 1901, May 5th, 1904, being date of application in United States.) February 24th. (Complete.)

3,894. "A new or improved accumulator plate." E. V. Gratze. February 24th. (Complete.)

3,899. "Improvements relating to motor-meters for continuous and alternating electric currents." W. Kostermann. February 24th.

3,912. "Improvements in the manufacture of filaments for incandescing electric lamps." J. H. Crawford. February 24th.

3,913. "Improvements relating to apparatus for enabling telephonic and telegraphic messages to be transmitted over the same line." C. Turchi and E. Brune. (Date applied for under Patents Act, 1901, April 2nd, 1904, being date of application in Italy.) February 24th. (Complete.)

3,918. "Improvements in and relating to electric fans." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) February 24th.

3,957. "An improved apparatus for the automatic ignition of gas, gaseous mixtures, or the like by means of an electric current." G. Hill. February 25th. (Complete.)

3,968. "Improvements in electricity meters." H. T. Brown. February 25th.

3,978. "Improvements in electrical alarm contacts for door locks." R. Blessin. February 25th.

3,979. "Improvements in supporting devices for electric conductors." B. J. Jones. (Date applied for under Patents Act, 1901, March 14th, 1904, being date of application in United States.) February 25th. (Complete.)

3,994. "Improvements in, or relating to, electrical troughs, conduits or the like." J. J. Bate. February 25th.

EXPIRING PATENTS.

We are informed by W. P. Thompson & Co. that about 860 complete applications for electrical patents were filed in the year 1891. Only 28 of the patents granted on these applications have been maintained for their full term, viz., 14 years, and being of considerable value, we give short abstracts of them below:—

647. H. H. Lake. (E. Weston.) January 13th, 1891. Relates to instruments in which a movable coil is so suspended in a magnetic field that it moves axially and also rotates about its axis when the circuit is completed, one form of which consists of a permanent magnet with bent radial arms connected with pole-pieces, between which is suspended a coil; the latter is carried by a spiral spring, to which is attached an index. When the current passes the coil moves in a vertical direction, and by reason of the spiral spring suspension, also turns axially. The form of the magnet may be modified, and an electro-magnet may be used, the coils of which are in series with the movable coil.

4,757. T. L. Willson. March 17th, 1891. Aluminium and other metals are extracted by subjecting the ore to the heating effect of the electric arc. In a suitable form of apparatus the ore or material to be reduced, such as corundum or precipitated alumina, is placed in a carbon crucible. The crucible is then placed in a chamber and rests on a carbon block in connection with a dynamo. A lid is then placed over the crucible and chamber. A carbon rod is inserted through an aperture in this lid, and the current passed. Powdered carbon is mixed with the ore or passed in through an opening to combine with the oxygen. In producing alloys, copper or other metal is first placed in the crucible and the ore on the top. The copper is melted and alloys with the reduced aluminium.

4,860. H. Howard. March 18th, 1891. Relates to electric apparatus for heating or welding metals. The carbon or pencil and the work, between which the electric arc is formed, are operated so as continuously to alter their relative positions, both longitudinally and transversely. The carbon is mounted in an eccentric holder on the shaft driven by suitable gearing from an electric-motor or other source of power. The shaft is supported in a carriage reciprocated by a quick-return mechanism, consisting of a pin on a wheel actuating a slotted link connected by a rod to a standard on a carriage. The shaft may be raised and lowered by a hand-lever provided with stops for regulating the position of the carbon above the work. The cylinder or tube to be heated is clamped by pivoted rods and screwed links to a support carrying the anvil under a hammer or press, and block of refractory material under the carbon. The press, hammer, &c., are operated by an electromotor or by other means. The carriage is movable on rails. A sheet of refractory conducting material may be placed between the carbon and the work. For melting, the metal may be enclosed in a box of carbon or other refractory conducting material.

5,167. F. E. Elmore and A. S. Elmore. March 23rd, 1891. Pipes and tubes made by electro deposition are formed on mandrels of electrolytically-prepared metal tubes. The mandrel is first straightened and trued and afterwards exposed to the air or to a sulphide solution to prevent the adhesion of the deposited metal. After a slight deposit has been made it is expanded by burnishing except at one end, or a thin mandrel may be employed from which the air may be exhausted on completion of the deposit; the mandrel also may be charged with compressed air, which is finally allowed to escape.

4,952. F. R. Lucas. March 19th, 1891. Relates to an apparatus for applying a serving of yarn to a rope or cable, especially to splices in telegraph cables.

5,406. H. C. Jobson. March 26th, 1891. Relates to a method of attaching insulators to telegraph posts. The cross-arms of telegraph posts are formed of channel iron or steel, and are secured to the posts by bolts. Distance pieces may be employed between the flanges of the channel-shaped arms. The stalks or supports for the insulators are insulated from the arms by washers of glass, china, &c. In one form, the lower washer is extended upwards through the arms as a tube, and a lath of wood, &c., is placed along the top of the arm.

5,988. J. Mason, J. Mason and W. S. Codner. April 7th, 1891. Relates to treads of the type described in specification No. 16,253, A.D. 1890. A rolled or stamped hard metal backing, with ribs turned back by a second pair of rolls or stamps, receives a soft non-slipping material of lead, tarred rope, or the like, which is compressed by passing the plates through rolls or under stamps. In a modification, a cast-metal plate receives the filling or packing, which is retained by staples or headed studs. Ribs may be formed underneath the plate for the purpose of strengthening the plate, or for forming a key when laid on a cement or concrete foundation.

8,227. W. P. Thompson. (H. O. Tudor.) May 13th, 1891. The plates or electrodes are provided on both sides with grooves, ridges, or projections crossing and intersecting each other in any desired direction. The plates may be made up of parts united at their extremities by solder or otherwise.

8,784. S. Evershed and A. E. G. Richards. May 23rd, 1891. Relates to order or alarm apparatus for ships constructed in such a way that the transmitter is merely a resistance switch, while the receiver consists essentially of two electro-magnets, A, B, the resultant magnetic field of which is changed by the transmitter, so as to rotate a magnet, F, which places itself in the resultant magnetic field. A pointer moving over a dial, is operated by the magnet F. As many, or twice as many, orders can be transmitted as there are resistances in the transmitter. The magnets, A, B, may be fixed while the magnet, F, rotates, or *vice versa*. The pointer may vibrate between certain angles, or may be made to completely rotate. The sensitiveness of the apparatus may be increased by magnetising the magnet, F, by additional magnets. The arrangement of circuits &c., corresponding to those of a Wheatstone's bridge for use as a steering telegraph. Two resistances, R^1, R^2, are connected through resistances, P, P_1, to a battery, &c., so that equal currents pass through both resistances, R^1, R^2. The tiller, or helm, is connected to a switch, and a hand-switch is connected to the switch through two galvanometers. When the switches are in agreement, that is, when the tiller is set in accordance with an order, there is no current through the galvanometers, but if the hand-switch be moved, the electric balance is displaced, as shown by the galvanometers, until the helm has been set in agreement with the order. Another arrangement of reply, or tell-tale steering-telegraph, may be used.

11,896. R. J. P. Cottancin July 13th, 1891. In buildings or the like made with an internal metal skeleton of wire netting or lattice-work, tubes are connected to or placed in the skeleton to form conduits for electric conductors. In some cases the skeleton itself may form a conductor, the cement, &c., of the wall forming the insulation.

12,117. E. Hartmann and W. Braun. July 16th, 1891. Relates to thermal current meters, in one form of which the current to be measured passes through a wire stretched between two fixed points and attached to one end of a thread or other flexible body, the other end of which is fixed; a second thread is attached to the first thread and to a pulley or drum carrying a pointer and a counterweight of equivalent spring which causes a movements of the pointer when the wire is heated and expanded by the passage of the current.

12,605. H. H. Lake. (Lacombe & Co.) July 24th, 1891. Relates to terminals or connections to carbon plates or electrodes for electric batteries. The battery carbon is preferably made with a head piece in which are made holes or cavities. In the transverse hole is a nut into which a screw-threaded stem screws after passing through a hole which passes down the middle of the head piece. A lock-nut or back-nut further serves to retain the screw-threaded stem in place. A conductor is secured to the carbon plate by a terminal.

13,124. H. Howard. August 1st, 1891. In heating and welding by the electric arc, when the work forms one pole and a pencil the other pole, the work is heated by radiation from a resistance interposed in the conductor leading from the source of electricity to the work or support on which the work rests. A conductor from the positive pole of the battery, &c., is attached to a metal clip resting on an insulating block. A rod of carbon or other comparatively bad conductor is held in the clip, and a second clip at the end of a metal bar is connected electrically to the work or support. Under the rod of carbon is a jacket of asbestos or other refractory insulating material. The pencil is connected to the negative pole of the battery, &c.

(To be continued.)